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RAILWAY LOCOMOTIVES AND CARS

OCTOBER 1953

R OFFICERS AND SUPERVISORS RESPONSIBLE FOR DESIGN, CONSTRUCTION AND MAINTENANCE OF MOTIVE POWER AND ROLLING STOCK

formerly
Mechanical and Electrical Engineer

October, 1953
VOLUME 127
No. 10

RAILWAY LOCOMOTIVES AND CARS

Founded in 1832 as the American Rail-Road Journal.

Published monthly by Simmons-Boardman Publishing Corporation at 1309 Noble St., Philadelphia, Pa. Entered as second-class matter, January 16, 1953, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price to railroad employees only in U. S., U. S. possessions and Canada, $2 one year, $3 two years, payable in advance and postage free. Subscription price to railroad employees elsewhere in the Western Hemisphere, $5 one year, $10 two years. All other countries: $7 one year, $14 two years. Single copies 50¢. Address correspondence concerning subscriptions to Robert G. Lewis, Assistant to President, 30 Church Street, New York 7.

Editorial and Executive Offices: 30 Church street, New York 7, and 79 W. Monroe street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D.C.; Terminal Sales bldg., Portland 5, Ore.; 1127 Wilshire blvd., Los Angeles 17, Cal.; 244 California St., San Francisco, Cal.; 2909 Maple avenue, Dallas 4, Tex.

Railway Locomotives and Cars is a member of the Associated Business Papers (A.B.P.) and the Audit Bureau of Circulation (A.B.C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. Printed in U. S. A.

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PRINTED BY PERIODICAL PRESS CORP., PHILA. 23, PA.

THE EDITOR'S DESK

The Price of Hot-Box Prevention

There have been many campaigns over the years with the objective of reducing hot boxes. Sometimes these efforts were confined to a single railroad or to scattered roads. Sometimes they extended more or less generally to all railroads. There is, therefore, nothing novel in the mere fact of another campaign. This one differs from earlier campaigns in several respects, however. Present freight-train operating conditions have become more severe than they have ever been before, because of heavier average axle loading, more rapid acceleration of freight trains hauled by diesel-electric locomotives and higher freight-train speeds. At the same time competition demands higher standards of reliability and regularity of freight-train operation.

In the present campaign for improvement several examples have been recorded which demonstrate that great improvement can be effected by strict adherence to the rules with respect to box packing and the inspection and servicing of journal boxes in trains. Similar results have been attained by similar methods in earlier campaigns. But the improvements effected were never permanent. Why were they temporary and what are the prospects that the results in the present instance will be any different?

The very term "campaign" implies a concentrated effort of short duration. In the case of hot-box epidemics, all supervisors concerned are directed to devote themselves to getting on top of the situation. Box packers and oilers are subjected to intensive instruction and their work checked. Journal-box inspection is made to conform strictly to the rules. Trains are held for as much time as is required to permit this, or enough inspectors are provided to do the work without yard delays to trains. When the occurrence of hot boxes ceases to be of epidemic proportions, the supervisors gradually transfer their major attention to other problems, box packers and oilers become careless, yard masters put pressure on inspectors to get trains out on the road, and journal-box conditions start a new cycle of gradual deterioration leading to another epidemic.

If the marked improvements in journal-box conditions now being effected by several railroads are to be permanent, the "campaign" aspect of the effort must be converted into a constant drive such as made the railway safety movement a success. Constant education of employees and a continuous search for means to keep up their interest in the subject must be carried on. Operating officers must be sold and resold on the advantage of having journal boxes properly cared for in yards rather than to have them fail on the road. When management becomes unwilling to pay the price of keeping the hot-box situation under control, it will again get out of hand.

C. B. Peck

EDITORIALS

The Printed Word

If you are out to do something no one has ever done before, it is a very good idea to stay away from a library, because in the library you will probably discover a number of authors who have already proved it cannot be done. On the other hand, if you are going to maintain a diesel-electric locomotive, it is a mighty smart idea to find out what there is to know about it.

There are many sources of information — but there are just three ways in which this information may be transmitted from one person to another. These are the voice, picture or diagrams, and the printed word. These, of course, must be abetted by experience.

The voice is fast and effective, but it is not permanent. The mind cannot retain all that is heard. The voice is aided by diagrams and pictures. They can be put together effectively in a motion picture. The many diesel schools employ both instructors and motion pictures and most of them have actual equipment which the students can operate or see in cut-away section.

In the diesel school, the student makes notes and is given a variety of books and pamphlets. These are of great value and can be referred to after the maintainer is away from the classroom or instruction car. But they, too, lack permanence because they must deal with specific types of proprietary devices. The locomotive builder must be constantly improving his locomotive to meet competition and the ever-growing demands of his customers. The result is that most of the school literature is out of date in a short time. And since this literature is concerned with how things should be done rather than why, it leaves a need for something more.

This something more, concerning things electrical, is included in the "Diesel-Electrics — How to Keep 'EM Rolling" series of articles now running in *Railway Locomotives and Cars*. They tell why, rather than how, and insofar as is possible, they deal with basic principles which apply equally well to all types of locomotives. They will not go out of date. To the young men coming into the shop these articles are a valuable source of information. They are so presented that subscribers say that reading them is fun, and not at all like studying. To the older man, they are invaluable. He cannot remember all he is supposed to know. He forgets, and to save face, he will not ask a younger man. With these articles at his disposal, he does not need to. He can look it up. The printed word which does not go out of date is his security.

Mechanically Cooled Reefers Not New

Ice-cooled refrigerator cars date back to 1867 when the first patents were issued to an inventor in Detroit and, by the first part of this century, many patent applications were being made for air-circulating devices in ice-bunker cars and also for mechanically cooled cars using ammonia as the refrigerant. Concerning these developments the magazine "Ice and Refrigeration" is quoted as saying in 1901: "Some of the American inventors seem to have endeavored to produce a car with as many mechanical complications as possible, forgetting that machinery should be as simple in mechanism as is consistent with the duties it is expected to perform." Ample justification for this comment is afforded by failure of all of the systems suggested up to that time.

The advent of quick-frozen foods in the late twenties gave impetus to renewed efforts to develop satisfactory mechanical cooling refrigerator cars and one of the first of these attempts was the Safety silica gel cars, built in 1927 and using sulphur dioxide as a refrigerant in an adsorption system. At one time this equipment was installed in 89 cars, but the idea was subsequently given up and the cars fitted with conventional type ice bunkers.

Two years later in 1929, the North American "FrigiCar" was developed, using a Baker mechanical system with axle-driven generator and battery equipment. Experiments were also conducted with an ammonia split-absorption system by the North American Car Company in conjunction with Fruit Growers Express, the latter also trying a combination of either dry ice or water ice as a primary refrigerant with axle-driven generator to power pumps which circulated a secondary refrigerant through cooling pipes. In 1942, a Waukesha mechanical cooling unit was installed in a General American car in meat packers' service.

In general, none of these developments showed sufficient promise to warrant extended use of the various equipments which failed in one or more of the following particulars: Too much added first cost, carrying charges, operating, or maintenance expense: lack of reliability in service; inadequate capacity; possible lading contamination with refrigerants used; fire hazard, etc.

Intensive efforts by railroads and manufacturers alike in the last decade has produced real improvements in

mechanical cooling equipments for refrigerator cars, to such an extent that a total of about 380 such cars are now in service or on order. True, mechanical difficulties are still encountered, such as inoperative controls, valve defects resulting in compressor failures, and instances of inadequate capacity due to exceptionally long hauls, high elevations, or wide variation in temperature extremes.

The need now, as in the first attempts to cool refrigerator cars mechanically, years ago, is for the simplest types of equipment, designed with ample reserve capacity to produce desired cooling under the most adverse operating conditions, but definitely engineered with a minimum of complicated construction and controls, thus promoting both increased reliability and reduced cost.

Is There a New Trend In Diesel Maintenance?

One of the things that characterized the operation of the early diesels some twenty years ago was the far greater care given to the upkeep of this new power than was customary to accord to steam. Preventive maintenance was the order of the day in the thirties. Parts were systematically renewed on a strict mileage schedule. Emphasis was on availability. Getting the assigned mileage from each diesel was rightfully thought to be of more importance than getting maximum life from individual parts.

As the diesel fleet grew diesel maintenance became a larger portion of the total cost of maintaining all power. And maintenance cost naturally began to assume greater importance relative to mileage. The pendulum began to swing away from renewing parts on a very conservative mileage basis, partially as a result of the greater importance of maintenance cost relative to mileage, partially because experience showed that some repair intervals could be increased and partially because of improvements in the parts themselves.

The pendulum has been swinging ever since. Some roads seem to be heading back to the old steam practice of squeezing every last mile from the locomotive before doing anything to it beyond trip servicing and emergency repairs. On a few it has become at least unofficial policy to run a unit until a part fails, repair or renew that part, then run until the next part goes. On several others, this practice has become an unintentional result of insufficient manpower, shop facilities and appropriations.

On the other hand there are a number of roads that have reverted to steam maintenance practices in a manner that is not incompatible with the original idea of giving the diesel top quality maintenance. They maintain diesel power in continual good condition by giving heavy repairs to the entire unit at specified time or mileage intervals. It would certainly be interesting and helpful to the railroad industry to be able to get a meaningful comparison of the preceding two diesel maintenance philosophies to see which is the more economical under what conditions.

Emergency Maintenance

Fixing it when it breaks down is definitely emergency maintenance. It is obviously a practice to be avoided where possible, and is endorsed by no one. Yet there are many common railroad practices which fall within the definition of emergency maintenance.

A car in the yard has equipment which should be inspected, but it is due for a train in 35 minutes and there is no one to look after it, so it has to go another trip. Perhaps it is because there are not enough men in the yard, and perhaps too many unexpected things have happened. In either case, it is a set up for equipment failure and emergency maintenance.

As another example, inventories are reduced to a point where a failed piece of equipment may have to be replaced by one taken from another car or locomotive. The repair was made, but it must be done over again when the borrowed equipment is replaced.

A diesel locomotive traction motor will usually run 250,000 miles between overhaul periods. It may go 350,000 miles and to make a showing, a railroad may arbitrarily set up a 400,000-mile interval. In some cases such overhaul mileage may be justified. Eventually, we may be able to extend it to a million miles, but to reach out too far is begging for emergency maintenance.

Large users of fluorescent and incandescent lamps have set up a method for maintaining light in buildings which provides an excellent example of controlled maintenance. It is called group replacement of lamps. Under this method a building is fitted first with new lamps. At the same time new lamps, amounting to 20 per cent of the total, are set aside for replacements. As lamps burn out, the renewals are taken from this 20 per cent reserve, and when the renewals are gone, all lamps in the building are replaced. Depending upon the relative cost of lamps and the cost of making individual replacements, the percentage may be adjusted up or down.

Railroad men are trained to meet emergencies. The very nature of the business requires the frequent exercising of ingenuity, but for that very reason, carefully planned maintenance is especially important.

Perhaps the group method of lamp replacement is applicable to nothing but lamp replacement on the railroads, but it would seem that the principle involved might find a number of applications.

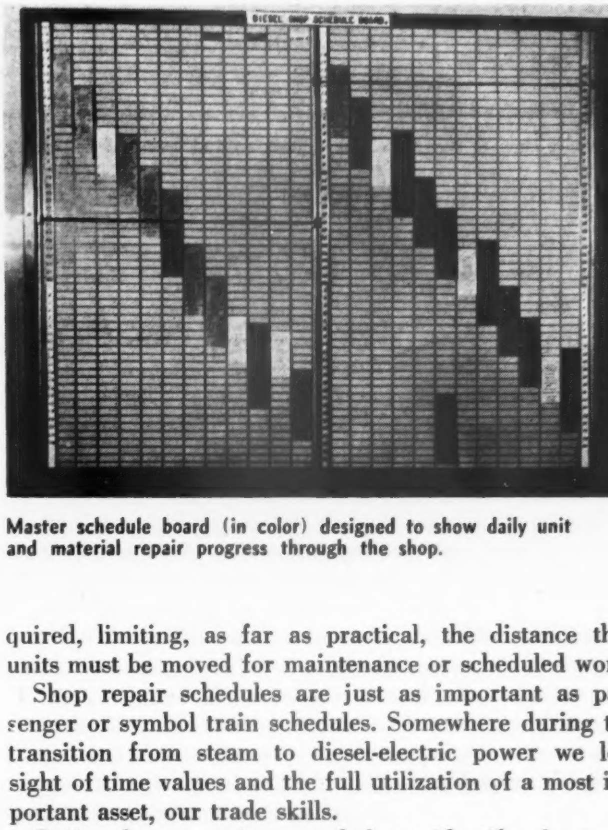
The Diesel Shop Pattern Is Slowly Taking Shape

A 19-road study by the shop planning committee of the L. M. O. A. reveals the opportunities for converting existing facilities and effecting substantial economies.

SHOP schedules are an old story for railroads, and were maintained with regularity until steam locomotives moved out. This picture changed with the diesel-electric locomotive. At the beginning, some exponents of this type power presumed that the back, or heavy repair, shop was going to be past history. Some assumed that progressive maintenance would continue diesel units in service through their lifetime.

As units began to show wear and require general repairs from usage, the railroads found their back shops with erecting and machine bays, overhead traveling and gib cranes, electrical and air brake departments, welding shops, transfer tables, and even shop pit tracks handy and could be utilized for heavy repair and maintenance work. Removal of hatches, changing engines, main generators, steam generators, air compressors, unwheeling, wheeling, truck repair work, all required similar equipment to that used when steam locomotives were being maintained. Heavy or classified diesel locomotive repair work can be performed much easier and more economically in the larger type shop with a minimum amount of necessary heavy equipment, than by attempting work in an inadequately equipped enginehouse, light running repair or maintenance shop.

Reports from nineteen railroads represented in the membership of this committee is conclusive evidence in that diesel operation, servicing, maintenance, and heavy repair problems are similar; likewise, problems with respect to shop buildings. Present steam locomotive back shops can and are being converted into modern, up-to-date diesel-electric repair shops for a fraction of the cost of new buildings. Location of heavy running repair and diesel back shops can better be determined by a thorough study of individual diesel unit operating conditions and territory, locating as near the hub of operation as possible. This is mainly to facilitate units being available for regular maintenance and heavy shop repairs when required, limiting, as far as practical, the distance that units must be moved for maintenance or scheduled work.



Master schedule board (in color) designed to show daily unit and material repair progress through the shop.

Shop repair schedules are just as important as passenger or symbol train schedules. Somewhere during the transition from steam to diesel-electric power we lost sight of time values and the full utilization of a most important asset, our trade skills.

Railroads use various symbols to identify classes of repairs for shopping units, and one has been chosen as an example of a shop schedule board.

For clarification:

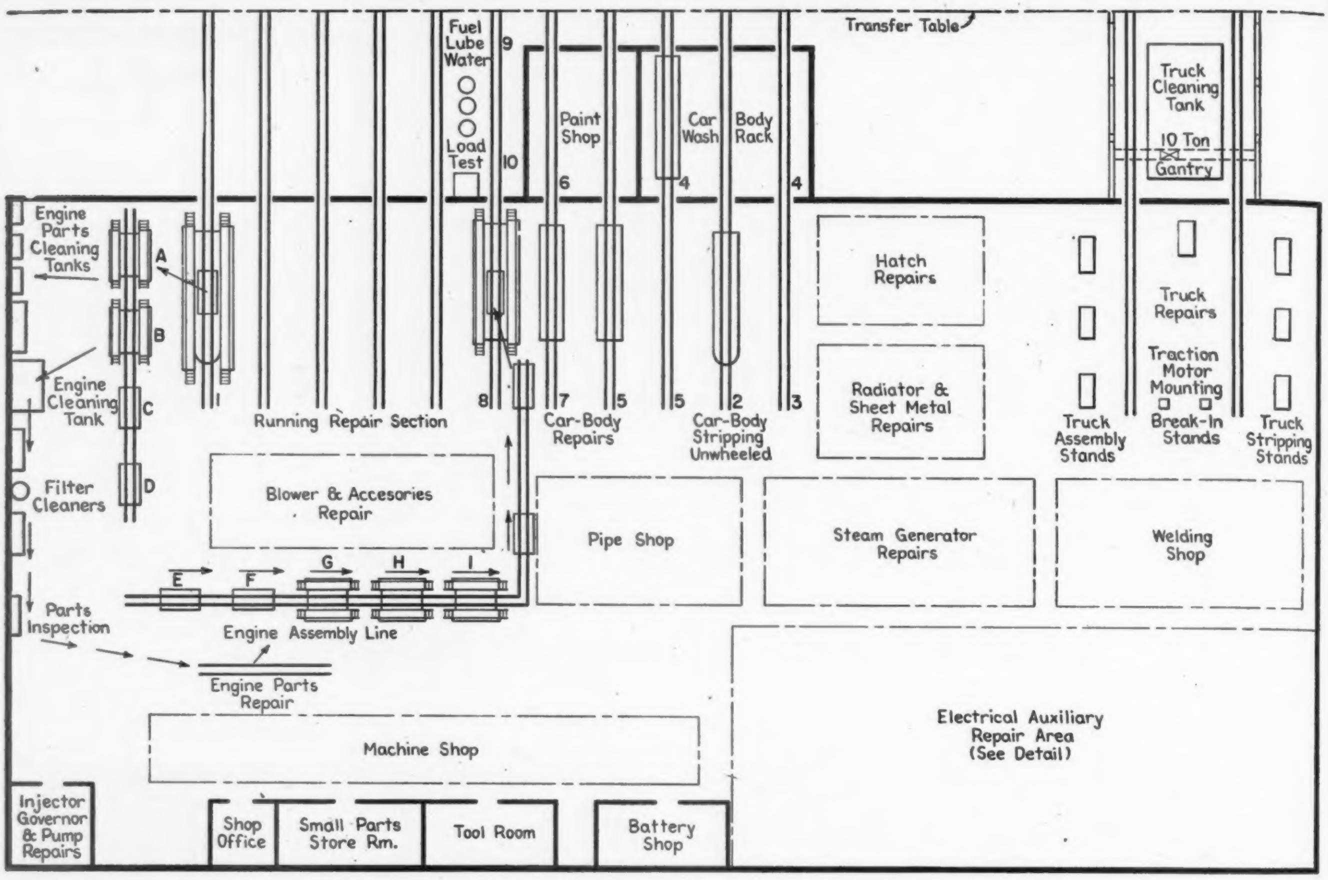
Class C—Two- or six-year light shop repairs (yellow card).

Class B—Four-year intermediate shop repairs (orange card).

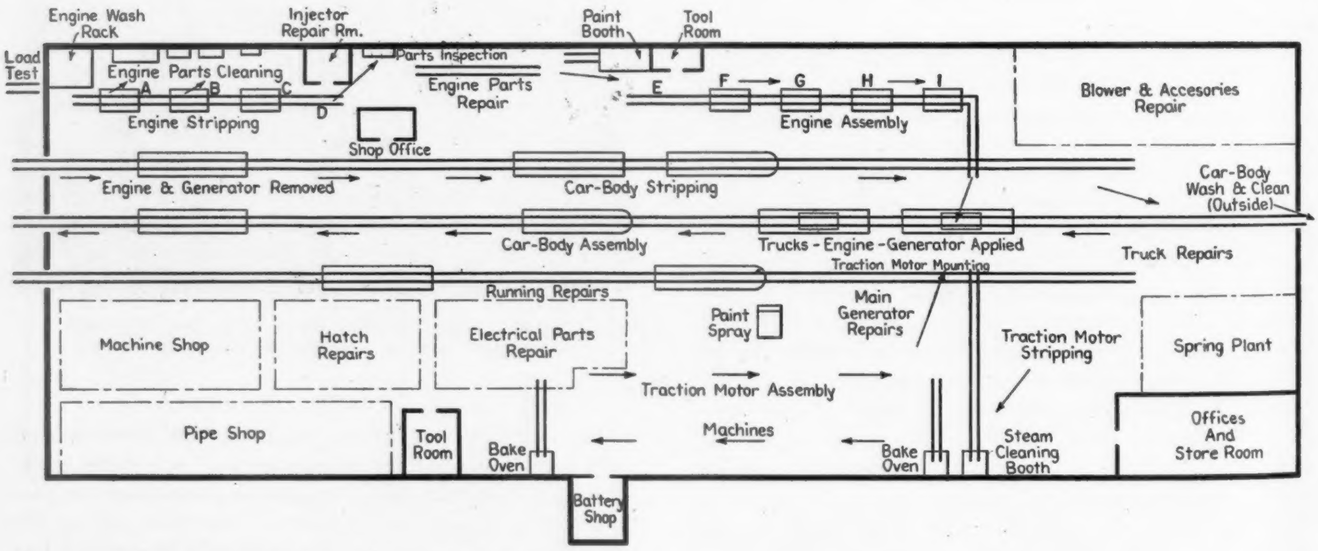
Class A—Eight-year general shop repairs (red card).

A master shop schedule board for use in offices, was developed with a color scheme to show daily unit and

This article is taken from the 1953 report of the Shop Planning Committee of the Locomotive Maintenance Officers' Association prepared under the chairmanship of E. L. Neeley, superintendent of shops, Union Pacific, Pocatello, Idaho.



Here is a shop of the transverse type converted from a former steam shop. This shop has a transfer table.



Arrangement of a diesel repair shop of the longitudinal type.

material repair progress through shop. On the left hand side are shown shop work days with Saturdays, Sundays, and holidays excluded, beginning with March in-dates for April shop output, followed by May. The right side of board shows schedule of units for June and July. Board was arranged for a hypothetical 500-unit railroad heavy repair shop, or approximately 6½ units per month, that can be used by smaller or larger shops, if desired, by merely reducing or adding days to color cards that represent units by class of repairs and work days in shop. Black tape across board attached to slide blocks, when moved to working day, indicates operations or repair cycle to be completed that day. Board illustrates the importance of in-dates. For instance, should the card representing a unit scheduled in-shop on March 24th be moved down the board two working days, it can be seen how shop load would be thrown out of schedule balance, interrupting shop progress, delaying other operations on work schedule, not only for this unit, but units following. The board is predicated on a stabilized force, man-hour control, material availability, and balanced shop load factors. There must not be peaks and valleys, periods of overload

or idleness, if efficient operation is expected.

Many centralized heavy repair shops reclaim and repair worn and otherwise defective items for system maintenance points, such as engines, pistons, liners, heads, main generators, traction motors, turbo chargers, engine blowers, steam generators, oil, water, and fuel pumps, governors and injectors. This is highly desirable and will assist in controlling shop load balance, *so far as it is economically wise.*

Unnecessary Inventories Are Expensive

Inventories are one of the greatest problems confronting us today. Material requirements must be available, not alone for everyday maintenance, but also in advance of shopping dates for units receiving classified repairs. Basic material lists should be determined for each classified shopping of unit, based on percentage of usage. Through study and experience this basic list can be supplemented by shop officers and supervisors for units operating under different conditions and territory.

Many railroads hold material procurement and control meetings with officers representing mechanical, purchasing, stores departments, manufacturers' and suppliers' representatives, who through experience are in a position to recommend material requirements in advance and arrange for delivery of replacement part before unit is shopped. Meetings can be held as much as six months in advance, with deliveries as close as 30 days before actual needs, affording manufacturers and suppliers time to secure parts considered critical items.

This practice will solve the problem of carrying excessive stock inventories that are not moving with regularity. Diesel-electric material costs are high, and material-on-hand inventories will soon get out of hand unless definite steps are taken for control.

Heavy Repair Facilities

The extent of facilities required for heavy maintenance and repairs in a centralized diesel shop would depend upon the amount of reclamation work each railroad desires doing on its own property, and if it was considered advisable to perform heavy running and accidental repairs in the same shop with classified repair units. Many railroads maintain sections in enginehouses equipped with drop tables, electric jacks for complete truck or single pair of wheels and traction motor changes, actually two maintenance operations at the same terminal. Heavy maintenance work, unless overhead cranes are available, would be difficult from the point of efficiency. Studies may develop such repairs as changing complete engines or cylinder heads, liners and pistons in complete sets, main generators, steam generators, and truck changes could be accomplished at a saving in heavy repair shop, provided adequate space is available.

How the Shop Is Used

Units moving into shop for classified or accident repairs should have exterior of car body and trucks cleaned and fuel, oil, and water drained before sending to shop for dismantling. Unit should be available in shop at the beginning of the first shift on the date shown on schedule, meeting schedule dates through repair cycle. Unit stripping area, Station 1 should be located under overhead traveling crane with a capacity of at least 150 tons for the unwheeling, removal of hatches, engines, main generators, air compressors, and steam generators. If the shop is equipped with drop table, a 25-ton minimum capacity crane would be suitable.

The unit should be set between a pair of two-level working platforms of sufficient height and of a length to accommodate the longest unit in operation, built with hinged platforms at top level so arranged as to permit lowering, providing safe working area at roof hatches for their removal.

While this is being accomplished, engine, main generator, steam generator, compressor, piping, electrical connections, and auxiliaries are loosened. The engine is removed and placed on a four-wheel dolly for movement to first dismantling station. The main generator, traction motor blower motors, steam generator, air compressor, and batteries lifted from unit and loaded on suitable trailers for delivery to their respective departments for stripping, cleaning, and repairs; couplers, draft gears, main reservoirs, and fuel tanks removed, if necessary.

The unit is unwheeled from Station 2, car body set on dummy trucks, one of which should be equipped with motor drive for independent movement; body and diaphragm stripping accomplished at Station 3; then moved to wash and cleaning platform, preferably outside shop, Station 4. After car body is cleaned thoroughly, it is moved to rebuilding assembly line for car body repairs, electrical circuits repaired or renewed as necessary at Station 5, and sent to paint shop, Station 6, then to Station 7 for setting of main generator, engine, steam generator, air compressor, and applying hatches to the unit in the reverse order in which dismantled, unit wheeled at Station 8. The unit is then moved to outside of shop; oil, water, fuel added, making adjustments, and engine run preliminary tests, loaded, and released.

Stripping and assembly of diesel units scheduled progressively through shop on a straight line if tracks are longitudinal; if transverse, use of transfer table or overhead crane station-to-station movement becomes the nearest approach to assembly line production that railroads have been able to develop in heavy repair shops.

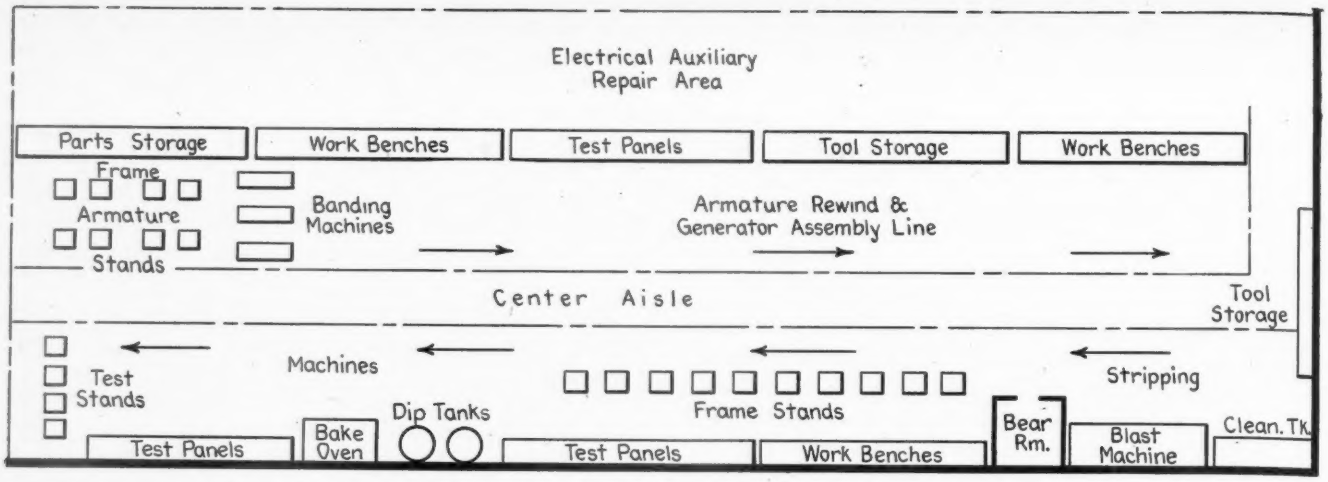
Each department such as electrical, engine, air brake, and truck repair, be independently equipped with cleaning tanks and repair facilities eliminating as much material cross-handling as possible.

Layout for Overhauling Engines

A typical area for engine dismantling and overhaul should each cover a floor area of approximately 20 ft. by 160 ft. which should provide sufficient space for dismantling and assembly lines. The entire area should be served by overhead traveling cranes, permitting handling of a complete diesel engine. Each dismantling and assembly station should be provided with a two-ton capacity electric hoist or monorail crane, pendant controlled.

Four principal stations are set up on the dismantling or stripping end of the engine bay. Dismantling and assembly lines should have narrow gauge trackage approximately 60 feet in length to suit engine dollies.

Station A should have fixed platforms on each side four feet above floor level for mechanics working at top deck for removing of covers, oil and fuel pipes, cam and rocker shafts, housings, stacks, and auxiliary generator; at the same time stripping of auxiliaries on both ends of engine. Three compressed air service connections for use



The electrical repair section of the transverse type shop shown in another drawing.

with power speed wrenches should be located on each platform, all necessary tools conveniently located on backboards within easy reach of mechanics.

Station B to have fixed elevated platforms both sides, four feet high by approximately 14 ft. long, with floor under platforms depressed 2 ft. 6 in. below ground level for convenience in working through crank case inspection openings, in removing cooling pipes, baskets, and bearings. Heads, liners, and pistons are removed as a unit and placed on material trailers with stands for holding a complete engine set for movement to cleaning stations.

At Station C, the engine is removed from the dolly and placed on a stand for removal of crank case from oil pan.

At Station D, the crank case is turned bottom up by the use of shop-built stands for removal of main bearings and crank shaft. Various accessories and parts remaining are stripped from engine; all are placed on special stands or carrying racks for removal to cleaning departments.

Parts, after being cleaned, are moved to reconditioning departments for inspection and reclamation. Cam and main crank shafts are thoroughly cleaned internally and externally and Magnaglo tested on specially constructed heavy-duty test benches. Crank case and oil pan, after cleaning, are inspected and Magnaflux tested for defects. Main bearing caps are torqued to normal position on crank case, alignments are checked for distortion with a telescope while setting on an accurate face plate. The crank case is then set on a rotating device to be inverted for the installation of the crank shaft; oil pan is placed on four-wheel dolly at head of assembly line track, Station E; and crank case lowered into position on oil pan.

As the engine progresses through the five assembly stations, E to I, inclusive, the last three of which are provided with side working platforms and depressed pits where needed, various parts and sub-assemblies are installed until the engine is completely assembled.

Working platform hand rails are actually air lines, having three outlets. This is to facilitate the use of air-operated speed power wrenches without the necessity for long lengths of hose which obstruct the floor area.

The space required for parts reconditioning work should be approximately 40 ft. by 140 ft. with one-ton electric cranes at convenient locations for handling parts. Equipment in this department consists of specially constructed shop benches, racks, cleaning vats for small parts, Magnaflux and Zyglo equipment, lathe with special attachments for honing and machining cylinder liners, two small lathes, piston lubrizing equipment, spring pack, cleaning devices, one small and one medium size emery grinder, 48 inch vertical or radial drill, valve grinding and valve seating machines, and portable tools.

An area of about 1,600 sq. ft. is required for overhauling governors, injectors, fuel, water, and oil pumps and it should be well lighted, pressurized, and air conditioned to provide a dust-free atmosphere and constant temperature. Here injectors, governors, and pumps are completely dismantled, cleaned and inspected for tolerances, defects, and worn parts replaced and reassembled. Injectors should be checked for spray pattern and performance before being returned to service. Heavier type equipment such as Bosch or Bendix fuel pumps should be thoroughly tested and calibrated on special calibrating equipment after being overhauled. After reassembling, governors should be given a thorough performance test on a governor test panel before being approved for reinstallation. All auxiliaries, such as mechanically driven fans, blowers, should be handled in the same shop area for reconditioning before application to diesel. Exhaust manifold, radiators, oil coolers, after coolers, and similar equipment should be repaired in areas adjacent to hatch repair bay.

On the basis of the above operation, centralized diesel repair shops handling overhaul work on engines and sub-assemblies should have about 12,000 sq. ft. of space.

Paint Shop

The paint shop building should have adequate room for painting hatches, trucks, and car bodies. A dust-free building with temperature and humidity control, well-ventilated, and in as fire-proof a structure as possible, should be provided, having automatic and manual fire protection equipment. The inside of the building should be as free of beams, columns, trusses, lockers, and benches as possible to avoid accumulations of paint and dust. Air used for painting should be free from moisture. All wiring and fixtures should be installed under strictest electrical codes, with flush-fitting reflectors. All main switches, and fuse boxes of safety type mounted outside building. Portable lights for interior painting should be explosion and vapor proof. All paints, thinners, and cleaning materials stored outside building.

DIESEL SHOP SCHEDULE APRIL 20, 1953

Unit Number	Class Repairs	Improvements	Inspn	In Shop, Unwheel, Unit Stripped	Cleaning Complete	Main Crank Shaft Bearings	Pistons Heads, Liners, Connecting rods Cam shafts, Auxiliaries, Blowers	Engine assembled, electrical fixtures complete	Set Main generator, engine, compressor boiler, wheel	Run engine, Preliminary tests	Load test, Release	CLASSIFIED REPAIRS Released to Date: Unit	Class	Cut	RUNNING REPAIRS Week Ending April 17, 1953: Unit	Out	Work Done
Frt F-3	B	A-B-P	S-Anl	4-13	4-14	4-15	4-16	4-17	4-20	4-21	4-22	Frt	B	4-2			
Frt F-2	A	M	Anml	4-16	4-17	4-22	4-23	4-24	4-27	4-28	4-29	Frt	B	4-8			
Pass F-2	B	P	Annl	4-27	4-28	4-29	4-30	5-1	5-4	5-5	5-6	Pass	C	4-10			
Frt F-3	B	B-P	Annl	5-1	5-4	5-5	5-6	5-7	5-8	5-11	5-12	Frt	B	4-16			
Frt F-3	C	P	S-Anl	5-8	5-11	5-12	5-12	5-12	5-12	5-13	5-14						
Frt F-2	C	A-M-P	Annl	5-12	5-13	5-14	5-14	5-14	5-14	5-15	5-18						
Frt F-3	A	M-P	S-Anl	5-11	5-12	5-15	5-18	5-19	5-20	5-21	5-22			-			
Frt F-2	B	P	Annl	5-19	5-20	5-21	5-22	5-25	5-26	5-27	5-28						

A - Automatic Transition
B - Ballast
M - Modification of Engine M.I. 5019
P - Paint
AX - Accident

(3) - Gen'l Sup't MP&M
(3) - Ass't Gen'l Sup't MP&M
(2) - Sup't MP&M
(2) - Master Mechanic - East
(2) - Master Mechanic - West
Division Sup't
Storekeeper

A sample of the weekly schedule report showing the dates on which specific items of overhaul work are due to be completed.

State, county and city laws should be studied by the legal department to assure full compliance before going ahead with shop construction.

Electrical Department

A railroad operating 500 units (on which this report is based) should be able to justify the expenditure required for facilities completely to overhaul and repair traction motors and generators. A detailed study should be made to determine the economy of this repair as related to each railroad as the cost for each unit repaired in your shop may exceed the cost of having it repaired on the outside. Factors to be considered are (1) existing shop space, (2) various types of units not suitable for streamline repair methods, (3) proximity of outside repair and service shops, (4) availability of qualified personnel, (5) time required for repair work, and (6) sufficient volume of work to permit repair operations to be handled on a production-line basis.

The most suitable arrangement of the facilities and equipment to handle traction motors and generators would require a rectangular department approximately 65 feet wide and 300 feet long, serviced with two overhead pendant controlled ten to fifteen ton cranes, supplemented with electrically controlled column cranes equipped with electric hoists and operating at a radius of not less than twenty feet.

The drawing of the transverse shop shows a shop arrangement divided into eight sections with four on each side: (1) cleaning and stripping, (2) motor production, (3) impregnating, (4) testing, on one side, (5) machinery, (6) armature production, (7) banding and undercutting, and (8) armature and generator finishing.

Because of the specialized nature of traction motor and generator repair work, machine tools and machinery of modern design and accuracy should be provided in the shop itself for turning, boring, drilling, and grinding operations to avoid travel time in moving them to and from the machine ship, and consists of the following: pedestal grinder, 24-inch lathe, 52-inch lathe, 600-ton press, Magnaflux, Zyglo or Dy-Chek, power hack saw, banding machine, two undercutters, large dynamic balancer, bearing press, horizontal boring and milling machine, 48-inch radial drill and pinion pullers.

The motor and generator department should be divided into two sides with a clear center aisle for trucking purposes. On the one side, at the beginning, should be located a so-called cleaning section with a pinion heater, cleaning frames, pinion puller, acid tank, shell or corncob blast, portable test surge comparator, degreaser, and bearing inspection room with cleaning tanks, wear limit gauges, and necessary testing and inspecting equipment.

The next section on the same side would be equipped with eleven motor frames to remove brush holders, coils, leads, and cleats, clean coils, spray inside red and outside black, reapply leads, coils, and brush holders, inspect and re-insulate connections. Also, in this section, at least three coil taping stands, dip tanks, baking ovens, benches for repair and storage of brush holders, motor leads, etc., equipment for seasoning, spinning, and grinding of commutators, and a ventilated spray paint booth. The motor stands should be in a line in the center of the section with the rest of the facilities placed along the wall.

Adjacent to the motor frame section should be located a lacquer tank, condenser, two baking ovens with armature cars, and impregnating tank.

The final section on this side of the building should consist of an armature assembly line, bearing press, bearing heater controls for motor testing, head rack, fixture for mounting armature in traction motor barrel, high potential testing set, and at least four motor stands to finish motor and two hour test run.

Directly across the aisle from the motor test stands should be at least four generator armature stands and four generator frame stands with two undercutters, dynamic balancer, and stand to burr and dress commutators.

Adjacent, or next in line, is a logical location for three banding machines, two brazing stands, a 52-inch lathe, power hack saw with a production-line arrangement, a pot soldering machine, an infra-red oven to pre-heat to solder, test stand (2,000 volts to ground), stand to install wedges, and a stand to draw down hot temperature bands, and also cool and remove temperature band with cooling platform.

The next section should consist of an armature production line with a stand to rewind armatures, a stand to insulate and apply equalizer coils, an infra-red oven (150 deg. F.), cooling platform, high potential testing set, a stand to band equalizers, a stand to place bottom coils, a stand to place top coils, a stand to place temperature bands, an infra-red oven (250 deg. F.), three stands to gauge and machine slots and tighten commutators.

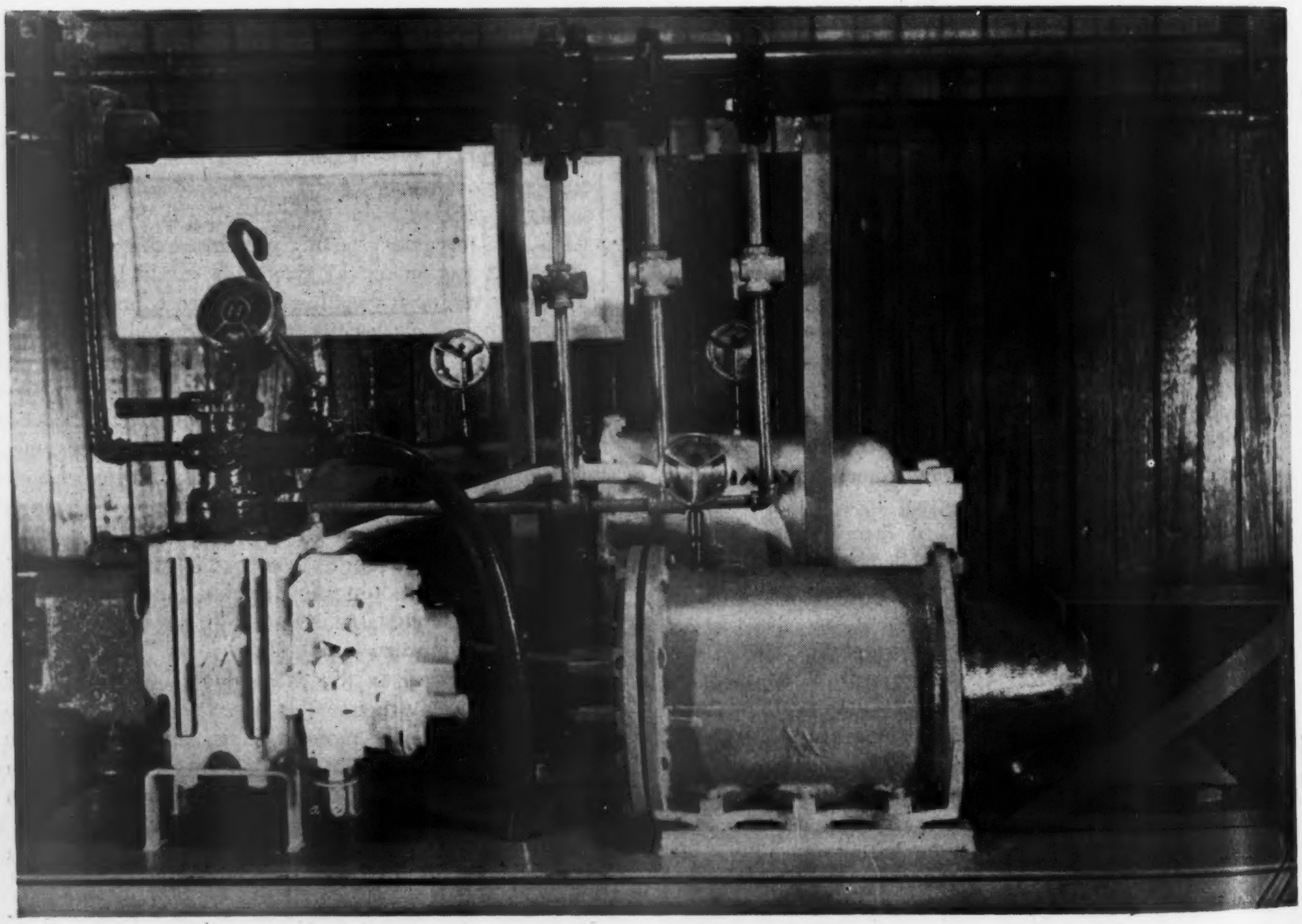
The final section should consist of machinery with a pedestal grinder, 24-inch lathe, 600-ton press, portable Magnaflux machine, horizontal boring and milling machine, and 48-inch radial drill.

Every heavy repair diesel electric shop should have facilities adjacent to the traction motor and generator repair area to inspect and repair the electrical auxiliaries such as auxiliary generators, alternators, auxiliary drive motors, reversers, relays, load and voltage regulators, meters, contactors, pressure and temperature switches and alarms, cables and wiring, train control, cab signal equipment, batteries, steam generators, train line jumper cables, miscellaneous electrical controls, and miscellaneous small motors.

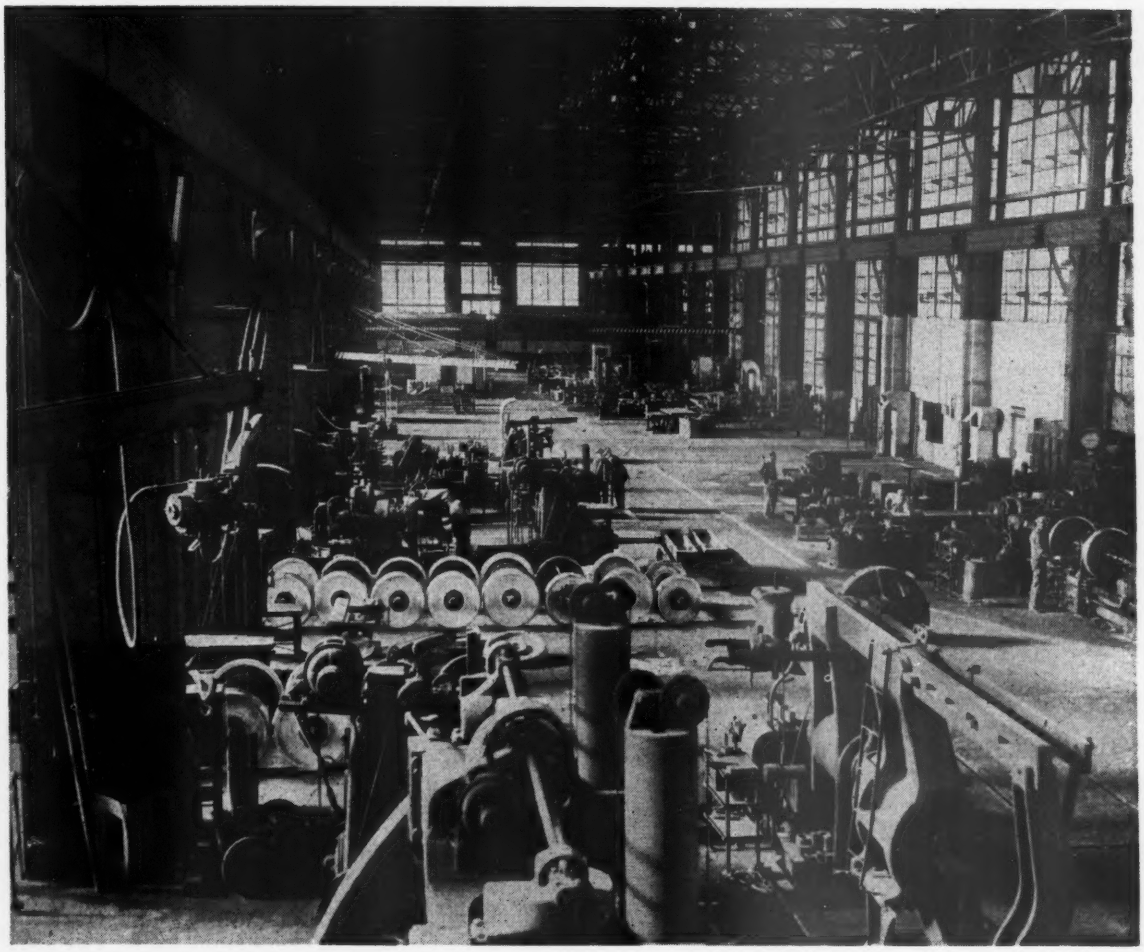
An Automatic AB Brake Assembly

An AB air brake assembly, installed in car repair shops of the B&O, and used exclusively for educating repairmen, inspectors and apprentices in the intricacies of brake operation, consists of a permanently-mounted single-car testing device, and a complete set of AB brakes, as well as three types of retainer valves, each with its individual cut-out cock so that anyone of the three may be tested for demonstration purposes. Pressure gages are mounted on the auxiliary reservoir, emergency reservoir and the brake cylinder to indicate pressure at all times. Pet cocks on trainline and emergency service pipe can be opened to set up leakage for demonstration purposes.

The entire assembly, with the exception of the 40-ft. trainline, is compactly mounted on a table 3 by 5 ft. so that the instructor and the apprentice stand facing the printed instructions mounted on the wall and can observe the results of every movement of the brake valve handle. The pipes are painted in appropriate colors, as shown on the Weshinghouse Air Brake Charts.



AB brake assembly used at B&O shops in educational program.



M-K-T Converts Waco Back Shop

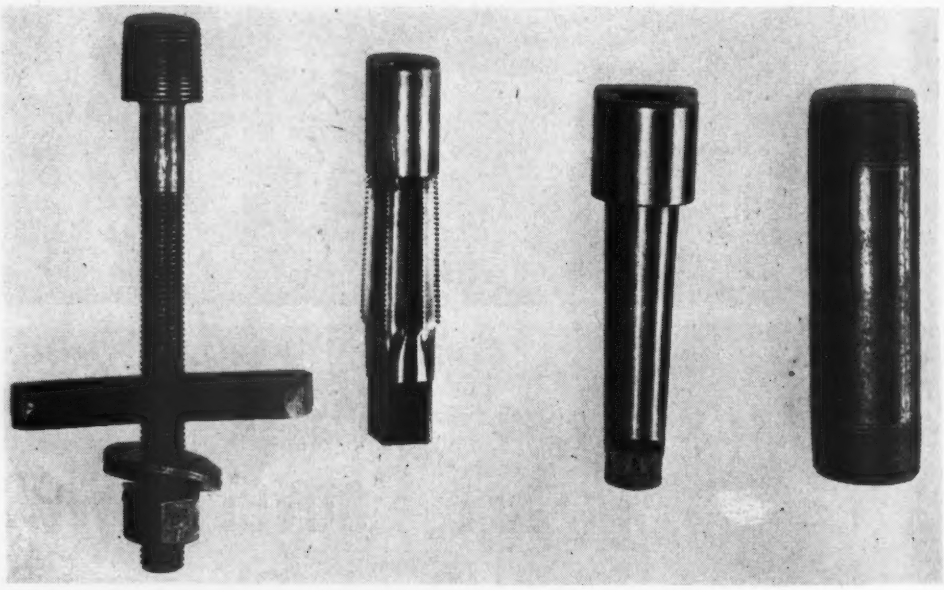
Shop changed from 100 percent steam to predominantly diesel work without repairs to one interfering with the other.

FOR the past several years the Katy has been busy at a program, now largely completed, of converting the large steam back shop at Waco, Tex., to diesel servicing and repairs. The conversion was handled in a definite prearranged series of steps by means of which the overhaul of one type of power did not interfere with that of the other.

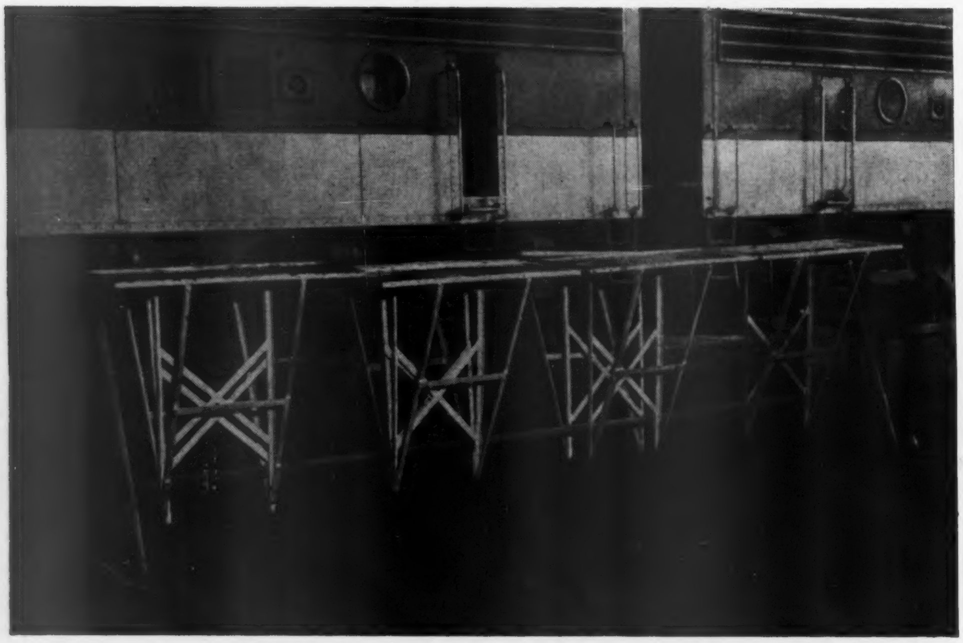
The building in which the interior arrangement and facilities were converted is L-shaped. The major dimension, termed east-west though it is at about 30 degrees offset from the true direction, is 558 ft. long. The wide part of the shop is at the west, and it is 225 ft. across; the narrow end is 155 ft. wide.

The building was originally laid out with nineteen 25-ft. bays in the conventional transverse-shop manner. Eighteen stalls were laid out, with the numbering beginning at the east end. Tracks were laid in all stalls but No. 17, and pits dug for all but 17 and 18. Actually, stall 17 was not a stall, but provided extra room between Tracks 16 and 18. Tracks 14 and 16 were through tracks; Tracks 9 and 18 extended out through the shop on the south side. The remaining tracks started and ended within the boundaries of the building.

These stands are adaptable to different makes of heads and lock in position at different angles by pins of the type on the right.



The pulling stud, ground-down tap, tap drive and the pipe nipple of the Alco injector sleeve remover.



Hanging tool tables from the engine compartment grab rail on road switchers gives a safe platform for tools at convenient height.

The wide end of the building extended from Tracks 12 to 18. The tracks of all but 14 and 16 were, however, the same lengths (75 ft.) as in the narrow part of the shop, and all tracks but 18 had a pit. The pits were 55 ft. long.

The shop was well equipped with overhead cranes. The high bay, the one along the south wall, had two traveling cranes, one with a capacity of 180 tons, the second 15 tons. The center bay had a 15-ton traveling crane, and in the north bay there was a 40-ton traveling crane.

The Series of Conversion Steps

The changeover of Waco from an all-steam shop, to a composite steam-diesel repair shop, to a diesel shop, handling only incidental steam work, took five years. The general policy followed was to take over portions of the wide, or west, end of the shop for diesel work, as the east end was not wide enough for three freight or two passenger units, and it had no through track. Selected areas in this end were saved for steam work. Steam repair work, unfortunately, could not simply be shoved eastward as diesel work required more and more space because all the entrance tracks were in the west half of the shop.

Prior to the arrival of diesel power at Waco, an average of eight class repairs were made per month. The steam locomotives were wheeled in on Track 16 and lifted by crane to one of the short pits to the east. While the locomotive proper was undergoing repairs at the pit to the east, tenders were worked in the general area surrounding Track 16 near the north wall. When repairs were completed to both the locomotive and the tender, the two were coupled together on Track 16 and wheeled out the south side as a unit.

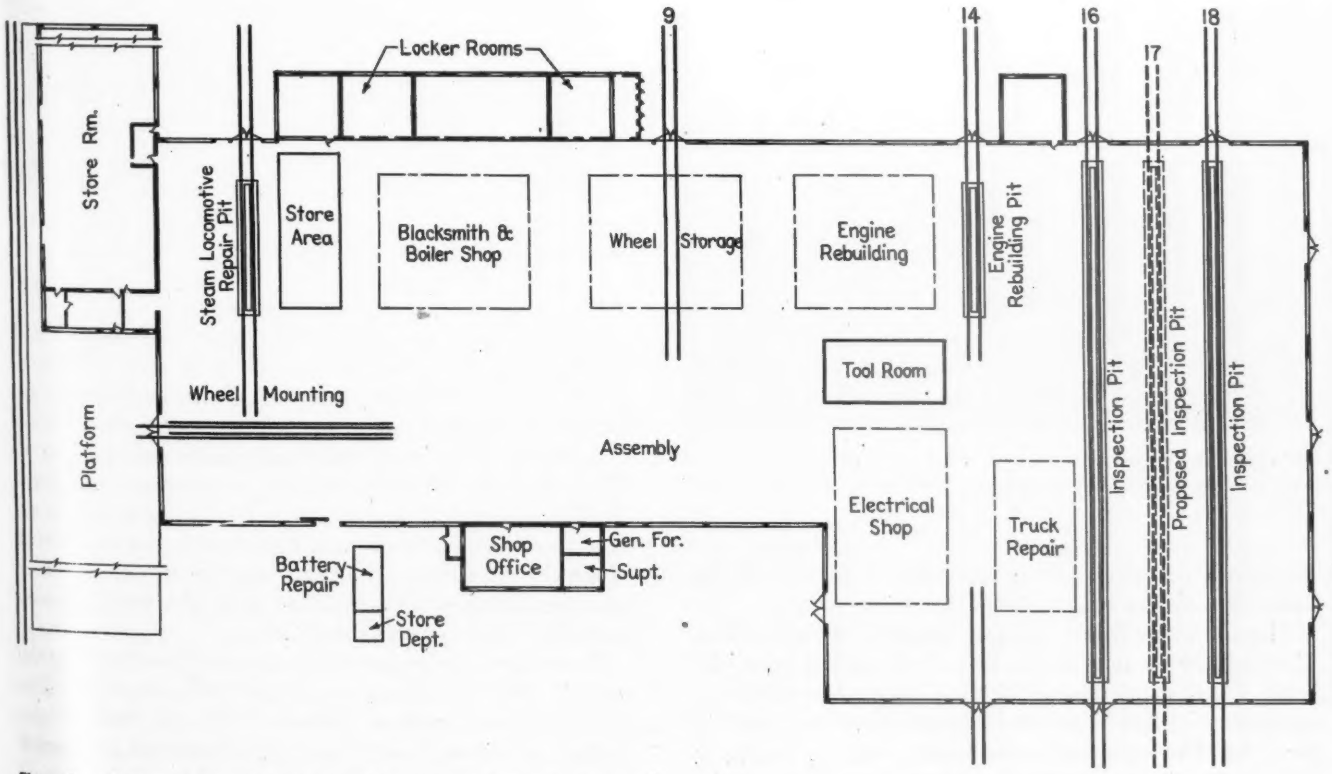
The fiirst diesel units to arrive were five switchers in March 1947. These were serviced outdoors, fueled south of the shop building, and sanded by hand. The first road power to arrive were two passenger units, and these were serviced on Track 16, the through track. While this was in the same general area that the tender work was still being handled, little interference occurred as only two diesel units were serviced each day. The tenders could therefore be spotted without difficulty between diesel servicing.

The next group of diesels to arrive were four freight units delivered in December of 1949. There was now a total of six units to service per day. Again there was not much interference between the steam and the diesel work as the steam locomotive classified repairs had now dwindled to three to four per month.

At this time Track 18 was not equipped with a pit and was used primarily to set the locomotive body on when changing trucks. Track 16 had only a short 55-ft. pit, which necessitated spotting two-unit freight or passenger locomotives twice. Switchers that had to be brought inside the building for work were either wheeled in on Track 16 or Track 14. Pit 15 was used for working the switchers on occasion after lifting from 14 or 16 by the overhead traveling crane.

More Changes After 25 Units

This arrangement worked satisfactorily until a group of 14 freight units were delivered in early 1950. With this total of 25 units to be handled, congestion again began to occur. Putting a full length pit under Track 16, thus avoiding double spotting, solved the problem for the time being. It arose again in the latter part of 1950 when eight road switchers were received. Two pits were installed to handle this new volume of diesel work, one



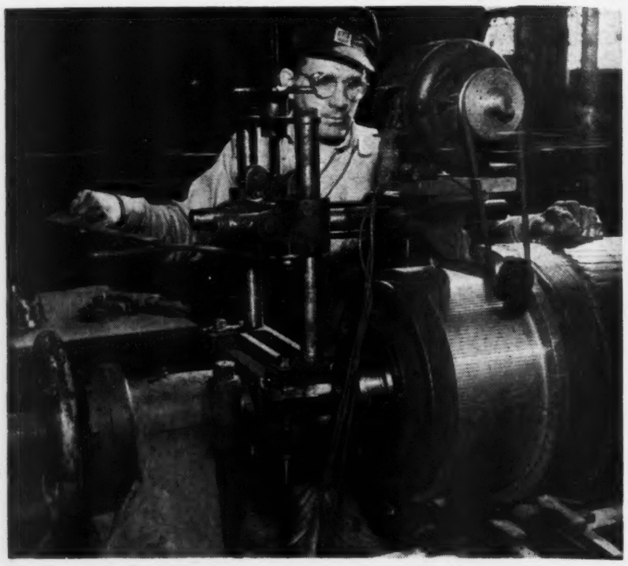
Floor plan of steam locomotive shop at Waco converted for diesel repairs.

Applying armature banding wire with the aid of an overhead crane to take up slack in the wire as it is tightened by rolling it on and off.

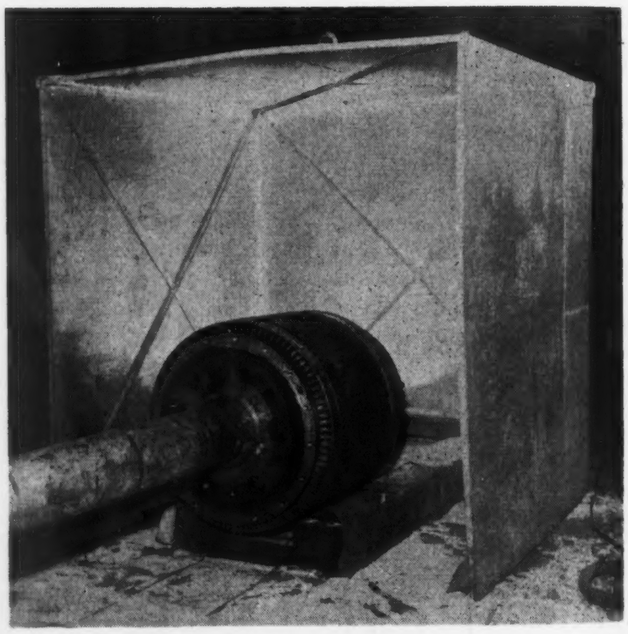
Main generator commutators are stoned in place before removal from the locomotive, turning the generator with the diesel engine.

220-ft. pit outdoors just beyond the north end of the building and the other under Track 18.

The pit under Track 18 was installed in early 1951. The installation of this pit and the lengthening of the track could not be done prior to this time because heavy machinery in the boiler and blacksmith shops stood in the way. The machinery scrapping program begun in early 1951 did away with the heavy part of the boiler



An adjustable-height arrangement on the banding machine is used for undercutting the mica on main generators and traction motors.



Here corn-cob blasting at 90-lb. air pressure is done to clean armatures and field coils before painting.

and blacksmith shop and made room for the pit and lengthening of Track 18.

About the same time that the improvements were installed on Track 18, five more road switchers were delivered. By this time there was enough diesel power at Waco that few steam locomotive assignments remained, and consequently there was little remaining steam repair work to be done. Work was therefore begun on tearing down the roundhouse, but retaining the turntable, which was removed the following year when the wye was completed for turning the diesel power.

Four more passenger units were delivered during the end of 1950 and the early part of 1951. These could be accommodated without difficulty with the facilities installed to date and with the virtually complete removal of steam locomotive work from the shop.

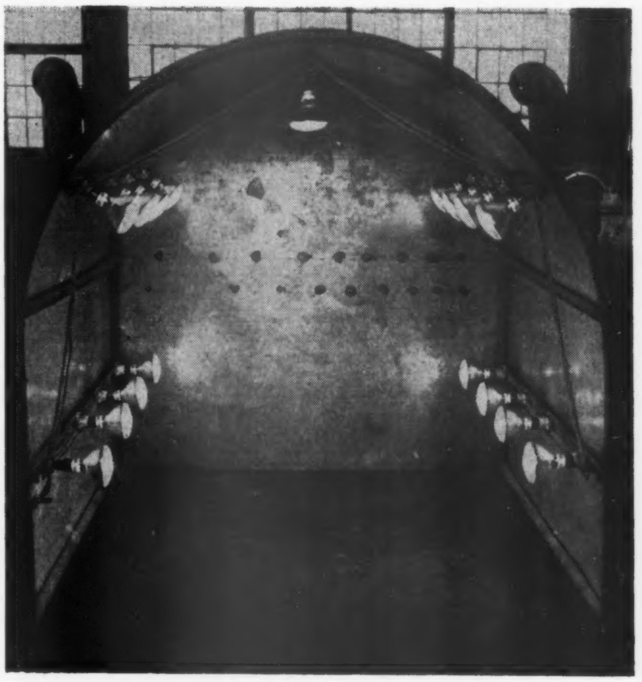
SHOP MACHINERY IN THE WACO SHOPS

Machine	Manufacturer	Uses
Coach wheel lathe (54-in.)	Putnam	Turn diesel wheels.
Lathe (42-in. by 19 ft.)	Putnam	Turn diesel axles and journals.
Radial drill press (6-ft.)	American	Ream and counterbore diesel cylinder heads, drill couplers and coupler yokes for bushings.
Boring mill (44-in.)	Bullard	Bore 40-in. diesel wheels.
Power hack saw	Peerless	Cut pipes and bar iron.
Triple head bolt threader (2-in.)	Landis	Thread bolts, from ⅜ in. to 2 in. diameter.
Axle lathe (30-in. by 10-ft.)	Sidney	Machine diesel axles, and polish crankshafts.
Engine lathe (22-in. by 11-ft.)	Lehmann	Turn small armatures, pins, bushings, bolts, and shafts.
Hydraulic press (100-ton)	Chambersburg	Press gears off and on diesel shafts, remove and apply outer bearing races to roller bearing journal boxes.
Tool grinder (30-in.)	Cincinnati	Grind reamers, cutters and facing tools.
Drill grinder	Sellers	Sharpen drills, ⅜ in. to 2 in.
Splitting shears (60-in.)	Quickwork	Shearing light sheet steel.
Steam hammer (1,100-lb.)	Massillon-Foy	Straightening diesel parts.
Face grinder with magnetic chuck	Diamond	Grinding diesel wheel forming tools.
Milling machine, No. 4	Cincinnati	Mill keyways and gears.
Shaper (32-in.)	Columbia	Miscellaneous machining.
Lathe (24-in. by 8-ft.)	Lehmann	Grooving diesel pistons, turning armatures, shafts, pins, lateral plates, bushings and bolts.
Cold cut saw (38-in.)	Newton	Cutting off heavy bar stock.
Hydraulic wheel press (600-ton)	Chambersburg	Demounting and mounting, diesel wheels and axles.
Universal grinder (12-in. by 4-ft.)	Cincinnati	Grind shafts and pins.
Plain radial drill press (4-ft.)	American	Miscellaneous drilling.
Boring mill (42-in.)	Bullard	Boring 36-in. diesel wheels and facing cylinder heads.
Punch and shears	Buffalo	Punching holes in sheet metal from ¼ in. to 1¼ in., and shearing flat iron, round iron, angle iron, channel iron, square iron, and T iron.
Boring mill (96 in.)	Betts	Boring tires and machining road equipment parts.
Die grinder	Landis	Grinding bolt threading dies.
Drill (20-in.)	Bickford	Drilling small holes.
Squaring shears (36-in.)	Niagara	Shearing tin and jacket iron.
Disc grinder (23-in.)	Chesly	Polishing and grinding diesel parts.
Steel bending brake (8-ft.)	Dreis & Krump	Bending jacket iron.
Planer (36-in. by 36-in. by 16 ft.)	Gray	Planing castings for diesels and road work equipment.

Future plans call for installing a through track with a 192-ft. pit at the location of Stall 17, and to connect Pits 12 and 13 to the lead track to facilitate storage. No platforms are contemplated for Stall 17, nor for 16 and 18 because of the method of truck changeout.

Trucks are changed by lifting the locomotive body with the 180-ton traveling crane as the shop is not equipped with a drop table. If platforms were installed, they would have to be set far enough away from the locomotive to provide clearance for lowering the lifter in place under the jacking pads. As this would largely nullify any advantages of platforms, and would provide an unsafe condition for stepping between a platform and the locomotive floor, no platforms were installed.

Shifts have been made from time to time in the locomotives handled at Waco, with the following power assigned at present: 8 Alco road freight units; 8 Electro-Motive road freight units; 10 Alco road passenger units; 4 Electro-Motive road passenger units; 1 Electro-Motive road switcher; 5 Fairbanks-Morse road switchers; 13 Alco road switchers; 1 Baldwin yard switcher, and 2 Electro-Motive yard switchers.



Housing equipped with infra-red lights for drying electrical equipment and for baking paint on armatures and field coils.

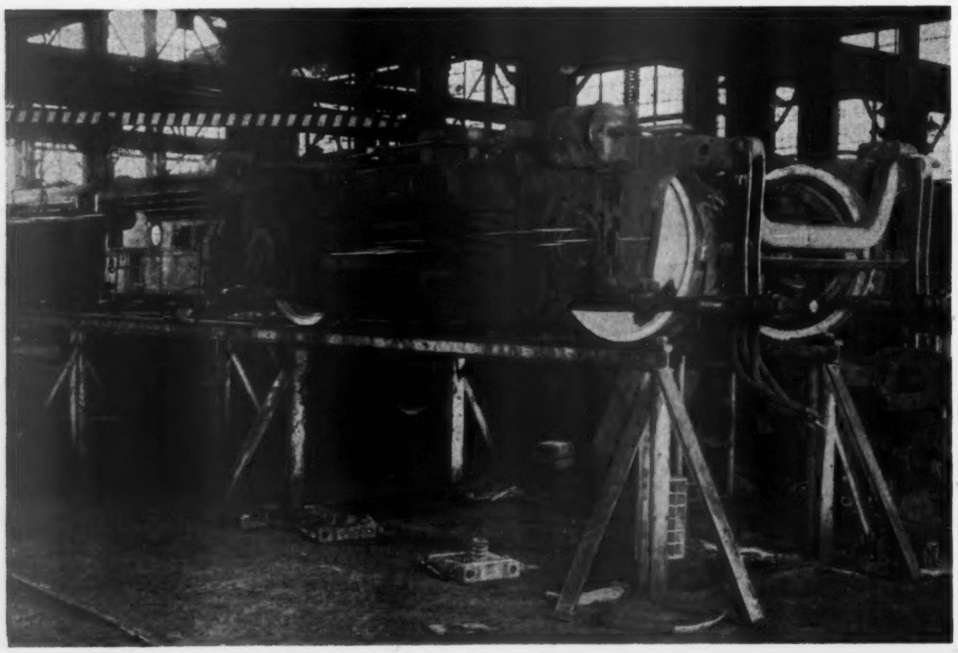
This comes to a total of 52 units maintained, all but five or six of which get complete maintenance at Waco. These remaining five or six are assigned to outlying points and Waco handles only annual repairs and heavier repairs. Approximately forty units are serviced each day and three heavy repairs made per month. Occasional steam locomotive repair work is handled on the repair pit in Stall 2.

Heavy repairs are given to freight and passenger units every two years, an average of 300,000 and 600,000 miles resp. Road switchers are also overhauled every two years, yard switchers every four years. An average of 9 to 10 working days are required to give complete classified repairs to a unit, including painting, which is done outdoors because of the mild climate. Oil filters and lube oil are changed on basis of test results only. No mileage schedules for renewal or mileage limits are set.

Complete repairs are made to diesel engines, trucks, locomotive bodies and small electrical equipment. Heavy maintenance work on traction motors and main generators is handled by unit exchange. Wheel work is done complete, including boring of both new and secondhand wheels. Axle work is done complete except for turning the wheel seat; when this work is required, it is handled at the Parsons shop.

Diesel units being shopped for heavy repairs are brought in on Track 16 or 18. The body is lifted off the truck and placed on Track 12, 13 or 14 by the 180-ton traveling crane. The trucks are dismantled east of the north end of Track 16 in the truck repair area. The traction motor is hooked up to a welder to stone the commutator, the remaining truck parts cleaned in a lye vat outdoors and the component parts delivered to the appropriate repair points.

The first operation normally performed on the diesel unit is stoning the main generator in place in the locomotive. By following this procedure, the generator can be conveniently turned by the diesel engine, and all of



Major truck work is done on elevated rails, without pits, to provide the same working height for all parts.

The indoor inspection pits (below) can be entered at the center from either side by extra sets of steps.

the copper from stoning and all of the mica from undercutting later can be removed when the armature is out of the frame and easy to get at.

The engine A-frame and the oil pan, after the moving parts are removed, are cleaned without removing the paint by a method originated by the Katy. The parts are placed in a cold (about 120 deg. F.) bath of Turco Mulsirex, left to soak overnight and washed off with hot water the next morning. This process is much cheaper and faster than hand cleaning, and it does not damage the paint as many hot solutions do. It is used for cleaning all interior painted surfaces.

Traction motors and main generators are cleaned by corn cob blast, with the corn ground to the approximate fineness of corn meal and blasted at 90-lb. air pressure in a special housing. The principal purpose of the corn cob blast is to clean the field coils and the armature before painting. Other work done on traction motors and main generators includes complete cleaning and painting of both, new bearings throughout, stoning of commutators and reworking brushes and holders.

Injector sleeves in Alco heads are removed with a

Engine A-frames and oil pans are cleaned without removing the paint by soaking overnight in this tank filled with cold solution.

The outdoor diesel pit where inspection, fueling, sanding, water and supplies are given to two- and three-unit locomotives at one spotting.

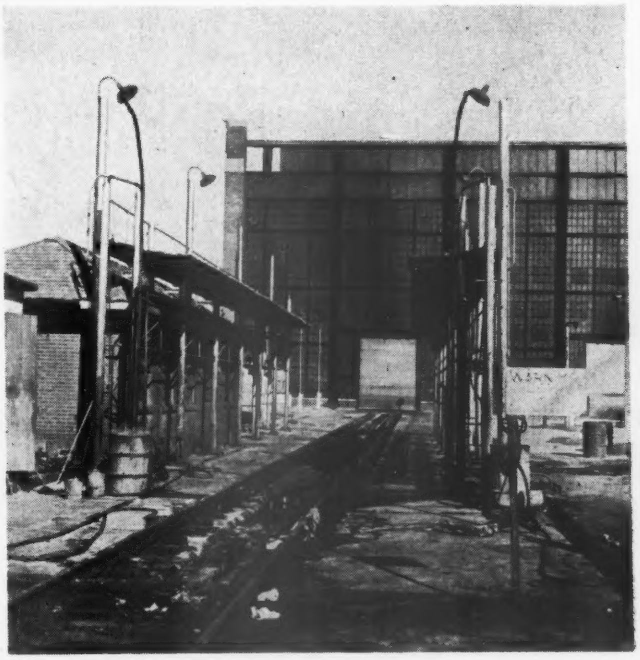
clever device developed at the Waco shops. It consists of a pulling stud, a tap with a sleeve, a socket drive and a pipe nipple. The tap has a $1\frac{23}{64}$-in. thread and is ground down on the bottom end to $\frac{3}{4}$ in. A steel sleeve, turned to .005 in. under the injector sleeve inside diameter, is pressed on this end of the tap as a guide. This tap is used to thread the injector sleeve for removal with the pulling stud.

The pulling stud has $1\frac{23}{64}$-in. threads on the large, or bottom end, and $\frac{3}{4}$-in. threads on the remainder. This is screwed into the tapped threads on the injector sleeve. The 1-in. by 6-in. pipe nipple is slipped over the stud, the cross bar put in place over the nipple and the $\frac{3}{4}$-in. nut started on the threads. Tightening the nut with a wrench pulls the injector sleeve out safely, quickly and easily without damaging the injector hole in the head.

Current Modifications

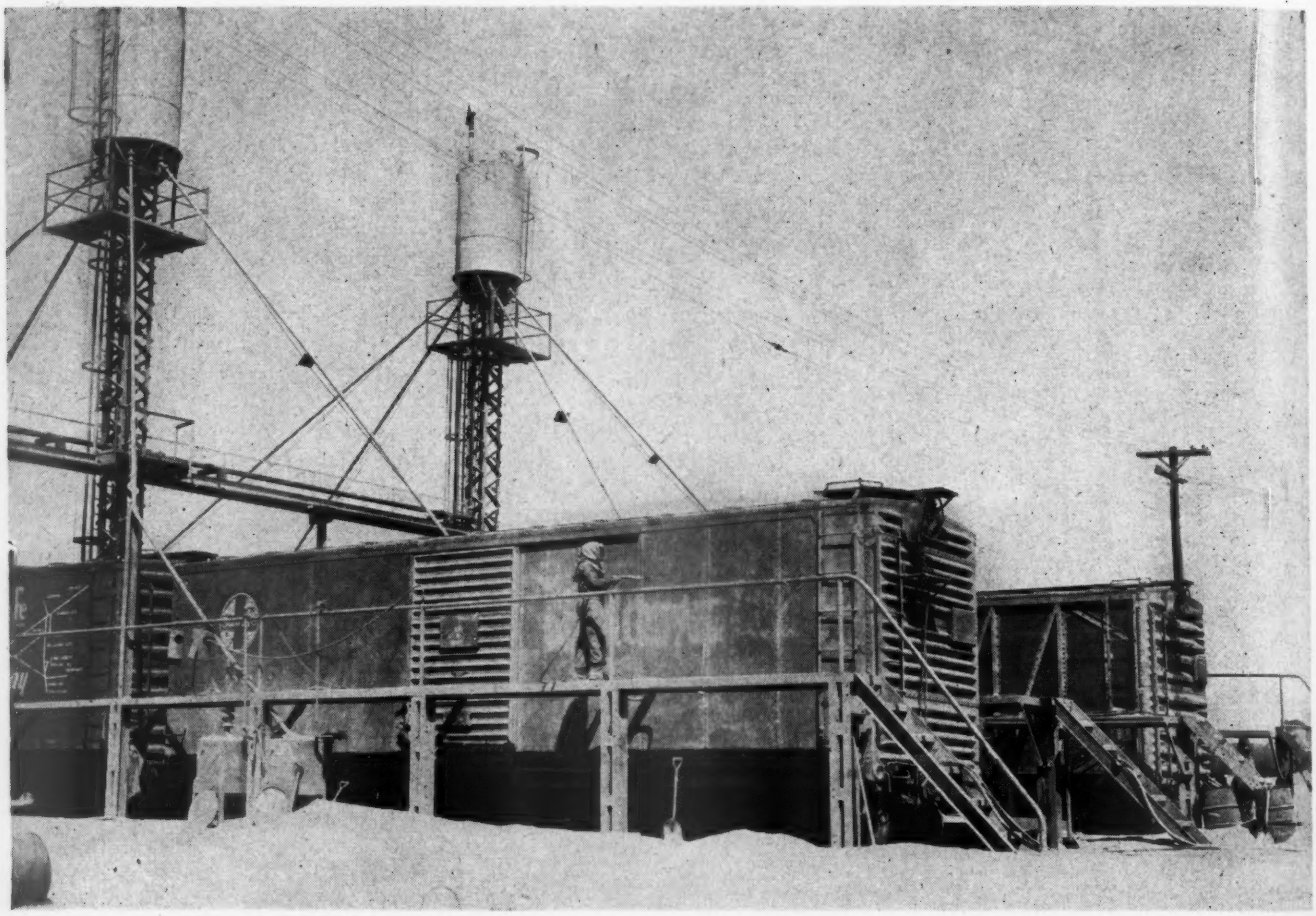
In addition to routine servicing and heavy repairs, two modifications are being made to diesels currently going through the shop. A drip pan is installed under the engine to keep oil off the fuel tank and out of the inside of the locomotive, and to keep dirt and other refuse from accumulating under the diesel engine.

The main section of the pan seals off the opening between the fuel tank and the locomotive body. The pan is large enough to catch all drippings from the entire area underneath the engine. Flanges along either side catch oil that drips off the engine sides, while channels at the two ends catch the oil from the flywheel and the governor. The channels drain to the sump in the pan, which is piped to drain outside the rails.



Spray pipes under platform and the locomotive-contour pipes in the foreground can be turned as desired from ground level.

The second modification comprises the addition of three body filters to each side of F-7 locomotives to bring main generator air directly inside without passing over the engine and becoming saturated with oil vapors.



Sandblast position and equipment at Emporia paint shop.

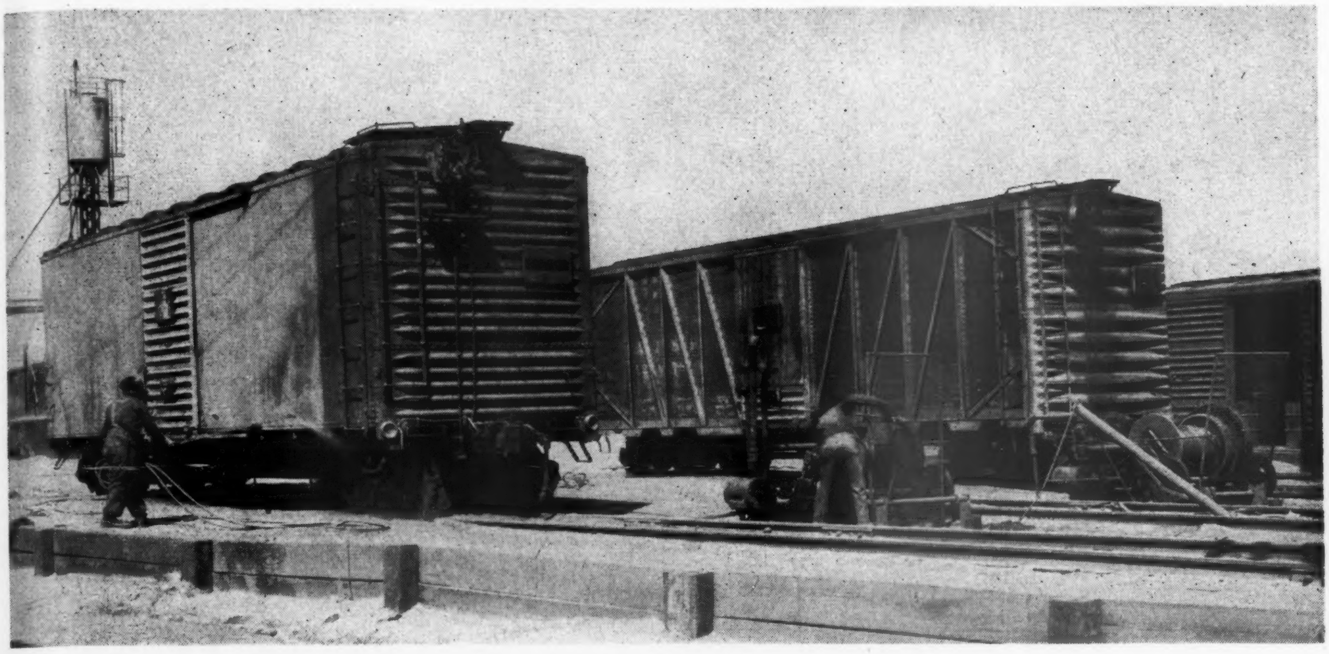
Santa Fe Paints 35 Freight Cars a Day at Emporia Shops

WITH a view to improving its freight-car equipment from the standpoint of appearance, as well as general resistance to corrosion and deterioration, the Sante Fe has instituted a painting operation at the company shops, Emporia, Kan., which are especially equipped and organized for efficient handling of the work. Sandblasting and application of the initial priming coat is done in a production line outside the Emporia roundhouse, 14 stalls of which have been equipped for adequate heating, ventilating and spray painting. Cars move a periodic intervals in and out of the roundhouse, via the turntable, to the track scale where the lightweight is stencilled on, cars inspected and carded for appropriate commodity loading.

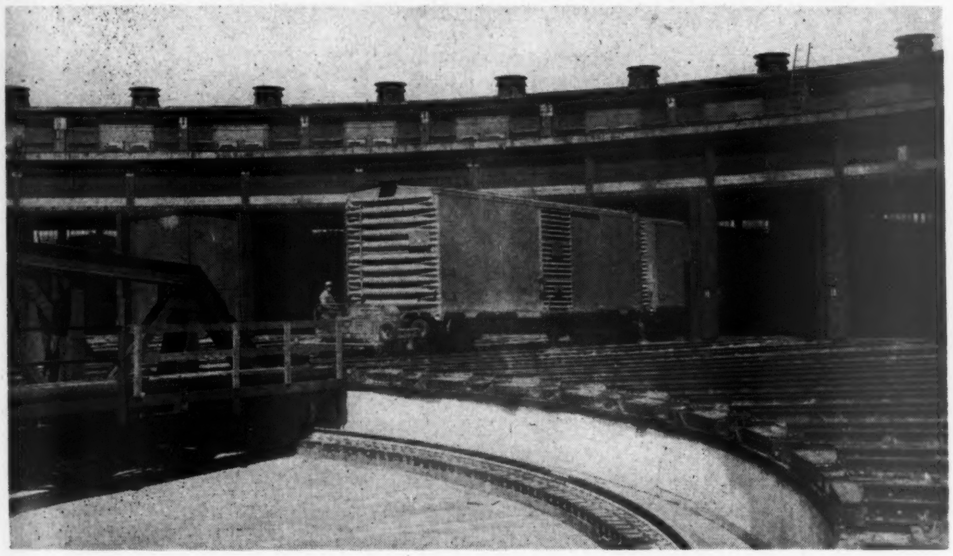
Beginning in October, 1951, the Emporia paint shop output of 3 cars a day was stepped up to 18 cars a day by December of that year. Subsequent improvements in operation permitted increasing the output to 35 cars a day, the total production of this shop up to April, 1953, being 15,819 Santa Fe cars of all types, including box, gondola and work equipment.

The shop is operated for the most part on a single shift with 13 painters, 8 sandblasters, 15 car helpers, 6 laborers and 2 motor operators, or a total of 44 men. This work may well be considered preventive maintenance of exceptional importance since the painting mentioned will help extend car life to the full period of 6 to 8 years between heavy repair shoppings.

The 29-stall roundhouse, no longer fully required for handling Santa Fe steam locomotives at Emporia, has been equipped for spray painting in 14 stalls. A brick fire wall was constructed to segregate the painting section, smoke jacks being removed and twenty-eight 36-in. ventilating fans installed. All lighting fixtures, fan motors

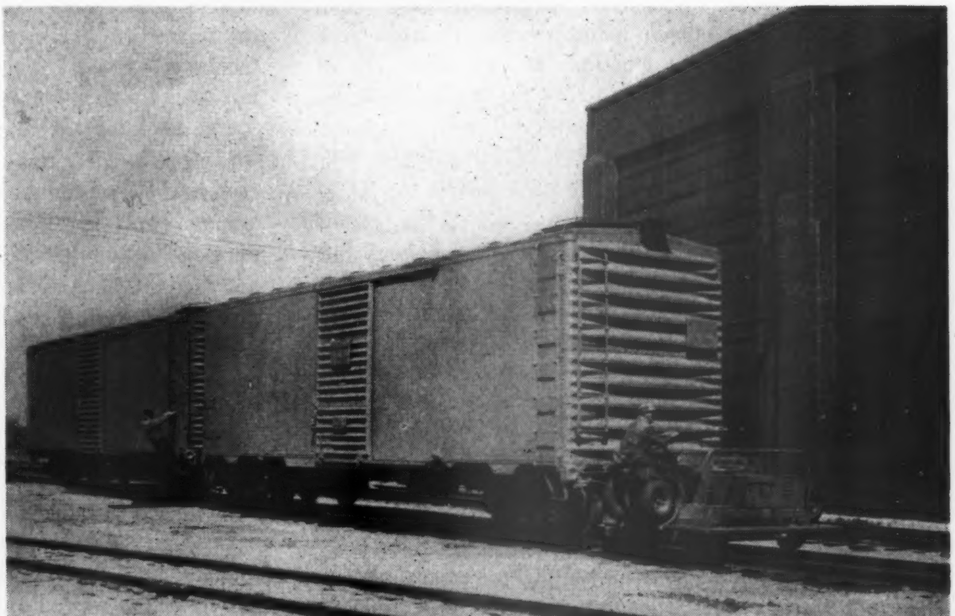


Air winches (above) pull cars to the priming position.



Trackmobile pushing two cars over the turntable and into a vacant stall in the paint shop.

Trackmobile moving two cars which have been primed to the roundhouse.





Left: One of the post-mounted unit heaters in the paint shop and 36-in. ventilating fan in clerestory window. Center: How pole gun is used in spray painting a car side. Right: Spraying cement on roof. Slate granules later applied give non-slip surface.

and heaters are fully protected and vapor-proof wiring installed throughout.

Heat is supplied by unit heaters already in place. Air at 105 lb. pressure is supplied for spray painting. Reducing valves, one at each stall, cuts the pressure to 20 lb. for stenciling. A heater coil is used to keep roof cement at the temperature necessary for satisfactory application. Paint mixing is done in a power-operated mixing machine located in a car body just outside the roundhouse. This car body is adequately heated and equipped with an overhead monorail and air hoist for handling the paint drums for storage to the 600-gal. mixing tank.

Paint is piped from the mixing tank underground to the roundhouse where it is within convenient reach for filling the pressure paint carts of individual painters. Similarly, paint primer flows by gravity to a stationary pressure tank from which it is delivered underground by pipe line to the outside paint-priming position and distributed to convenient locations at two tracks. Roof cement is handled at the paint shop in a 55-gal. tank, mounted on a 4-wheel wagon equipped with a barrel pump. Another tank on the same cart carries red granules used to give a non-slip roof surface when lightly scattered on top of the roof cement.

Method of Operation

At the Emporia freight-car paint shop, the entire crew of 44 men works 8 hr. a day, five days a week. The only additional help consists of one painter and helper on an 8-hr. night shift who finishes painting and stenciling up to six cars a night which may be left in the roundhouse at 4:30 p.m. One painter primes all cars after sandblasting on the day shift and two painters apply finish coats in the roundhouse during the day.

Repaired cars in need of painting are carded to Emporia from other points on the Santa Fe system and set 18 on one track and 15 on another ready for sandblasting. This operation is performed on two tracks, two cars at a time, after the journal boxes and backs have been protected with burlap. Two men work on each side of each pair of cars, one on the ground and one on a 7-ft. high scaffold. The average time is 15 min. for sandblasting and 5 min. to move each pair of cars.

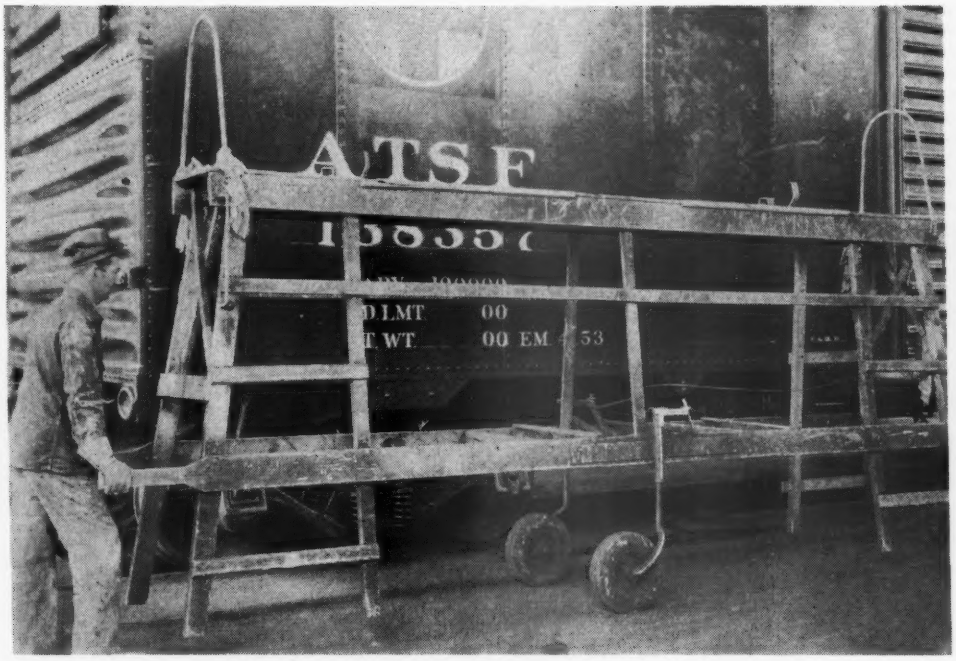
The cars are then pulled by air winch close to the priming position where about 8 min. are taken to blow sand and dust off the roofs and cover the truck sides and wheels with burlap. The cars are moved 15 ft. further to the painting position and given a priming coat, using a pole gun with paint supplied from the pressure paint line and compressed air at 105 lb. pressure. One man averages 12 min. per car.

Two painters work on adjacent sides of four cars in the paint shop and, using pole guns, apply a brown mineral mist coat followed immediately by a second heavy coat which dries quickly with the first. This painting operation takes about 10 min. per car side. The trucks are given a light coat of paint, care being taken not to get any great amount of paint on wheels.

Car roofs are given a coat of cement by two men and helpers who average 35 car roofs for painting and application of slate granules in eight hours. Two men and two helpers apply large stencils on 35 cars a day. The production on small stencils is seven cars a day for one man and helper. One painter and helper apply emblems to practically the full day's production of 35 cars. The paint used in stenciling also is quick drying and, in 45 min. or less, cars are ready for movement out of the roundhouse to the track scale, as mentioned.

Stenciling

Stencils are made of zinc at the company shops, Topeka, Kan., the large ones being machine cut and the smaller ones formed with acid. These stencils are repaired in the local Emporia sheet metal shop and sometimes last to stencil upwards of 8,000 cars.



Two wheel paint platform can be moved by one man and dropped to the floor at any desired position by pulling the trip wire at the right.

Two paint-gun and stencil-cleaning troughs are conveniently located in the shop and have adjoining metal-top cleaning tables.

Painters are responsible for cleaning their own guns, but a helper and labor are especially assigned to clean stencils. Lacquer thinner and varnish remover are supplied in two cleaning troughs with metal-cleaning tables. Pole guns are used for prime and finish painting, as stated. Cup-type guns are used in stenciling. A Tennant floor-cleaning machine is used when necessary but, with the quick-drying paint used, the floor sweeper generally removes most of the paint. Slow-dry paint has to be scraped off and burned.

Protection equipment supplied to sandblast operators includes a Healthguard mask with rubber-face plate, two laminated lenses, head harness and ventilating equipment, including filter cartridge, plus canvas sandblast hood and gloves. This equipment is furnished by the Chicago Eye Shield Company. Spray painters use respirators with chemical-type filters supplied by the American Optical Company, Chicago.

The sand utilized in sandblasting these cars consists of white silica sand from Ottawa, Ill., delivered by hopper cars or drop-bottom coal cars, unloaded into a pit and elevated mechanically to overhead storage tanks. From there, it falls by gravity to a steam drier and then is mechanically screened into an underground pressure tank from which it is elevated by air to overhead sandblast tanks of 27 cubic yards capacity, installed for this particular job, as shown in one of the illustrations. The four-inch pipe conducts sand by gravity to sandblast tanks under the scaffolds mentioned. Air pressure at 105 lb. is supplied to the 1-in. sandblast hose and nozzles. The latter consists of aluminum shells with barium-inserts having 5/16-in. center holes, supplied by the A. B. Stoody Company, Whittier, Cal. The average life of a nozzle is about 10 months or 5,000 cars. Sand which drops to the group is picked up by a crawler type crane with 10 cu. ft. hydraulically-operated lift shovel on the front and dumped in the sand car, then returning to the pits and being used over again about 4 times.

The Santa Fe's Diesel Motive Power

Concluding installment of operation and maintenance study in which recommendations are made for setting up repair facilities and details of cost are given.

ORIGINALLY, maintenance schedules were set up predicated on straight mileage basis as a yardstick for performing certain work. However, as additional locomotives were placed in service and utilized on extended runs, it became apparent that in order to properly control the maintenance and get locomotives to home terminals in time for this work it was necessary to group maintenance on them at intervals, using date of Federal I.C.C. inspections as indicated on the cab inspection card, or at certain intervals between these dates. In this manner, all persons concerned can determine when locomotives are due certain maintenance by merely checking the cab card; and this method is now being utilized, and each time locomotive has certain work scheduled to be done, at time of trip inspection, 10-day, semi-monthly, monthly, quarterly, semi-annual, and annual inspections.

The application of proper tonnage ratings from the standpoint of preventing damage to electrical equipment and also for utilizing a locomotive to its greatest advantage, is an important problem. Over-tonnage causes extensive electrical repairs, and insufficient utilization of the hauling capacity of the locomotive results in not obtaining the greatest economies offered by it.

Climatic conditions have presented many problems for the diesel locomotive, and even on the latest locomotives difficulty is still experienced in storms due to water or snow grounding out the electrical equipment. With the advent of winter it has been necessary to winterize the locomotives to eliminate some of these difficulties. The method varies with the many types of locomotives.

Past experience has proved that on the long, extended runs such as exist on the Santa Fe, it is necessary to have a good reserve of power to run off delays and better protect the service in case of a power plant failure, and to provide a locomotive which is flexible enough to handle a train having variations in tonnage and negotiate heavy mountain grades without helper service. Due to these reasons, the majority of our locomotives in cross-country passenger service and main line freight service are 6,000 hp. Based on the present-day increased demands for large trains on expedited schedules, it appears that even larger locomotives will be required in the future.

The extent of economy is varying with operating characteristics, availability and utilization of the locomotives, and management policy. Past experience has indicated that greatest economy can be obtained through full dieselization. On the Santa Fe, there was a 44.3 per cent saving in freight operation between Chicago and Kansas City the first nine months of 1950 over steam operation for the entire year 1939. The first nine months of 1950 were the first nine months that that territory had been completely dieselized for freight service. It was also found there was only a 39.3 per cent saving for the first nine months of 1950, compared with the entire year 1944 during which year there was joint steam and diesel operation on that territory in freight service.

In analyzing present-day diesel locomotive costs, there is not a great deal difference between money spent for repairs and that spent for fuel; however, several years ago there was considerable difference, as there has been a considerable increase in the price of fuel in the past

Ten Rules for Guaranteeing Maximum Economies with Diesels

1. Selection of territory to be dieselized which will best fit in with the operating characteristics of the railroad.
2. Proper selection of the types of locomotives to be used which are best adapted for the territory where they are to be assigned, taking into consideration the schedules to be maintained and the size of the trains to be hauled.
3. A careful study of grade and track conditions and locomotive characteristics insofar as hauling capacity is concerned, in order to determine proper tonnage ratings to be applied.
4. The grouping of similar types of power in order to keep required facilities and material stocks at a minimum and afford greater opportunity for all to become better informed on the type of power being used.
5. The construction of proper type maintenance and servicing facilities, and the most desirable location for same, taking into consideration the ability of the diesel locomotive to operate for long distances between maintenance inspections and refueling, in order to eliminate unnecessary facilities.
6. The complete elimination of all facilities which are not required for diesel operation.
7. Possible changes in track layout to provide for the handling of larger trains which the diesel locomotives are capable of handling.
8. A thorough instruction program for shop and road personnel.
9. The establishment of the maintenance and repair program.
10. The possible use of diesel locomotives in joint passenger and freight service, in order to meet fluctuations in demands of these two services, as well as adequately protect the service in case of passenger locomotive failures.

The author of this paper, Part I of which appeared on page 84 of the September issue, is T. T. Blickle, mechanical superintendent, Coast Lines, Santa Fe. The paper, as mentioned previously, was awarded a prize by the Pan American Railway Congress.

few years. In 1951, of the total spent for repairs, lubricants, and fuel, 50 per cent was for repairs, 47 per cent for fuel, and a little over 3 per cent for lubricants.

Insofar as diesel repair costs are concerned, in 1951 approximately 32 per cent was chargeable to repairs to diesel engines, 30 per cent chargeable to electrical equipment, and approximately 38 per cent for repairs to the rest of the equipment.

A steady increase of diesels in freight service has brought about a steady increase in cars handled in train, in net ton miles per train mile, and in per train hours.

Consideration should be given to the axle loads so that they will not exceed the track limitations, especially insofar as shear stresses are concerned, as well as bridge conditions and track clearances.

It will be necessary, in addition, to determine the need for equipping the locomotive with dynamic brake. Experience on the Santa Fe has proved that the use of the dynamic brake in mainline freight service has eliminated stops for wheel inspections and wheel cooling on some of our heavy descending grades. Also, it has brought about a substantial reduction in brake beam failures, overheated wheels, and brake shoe renewals. On our Coast Lines at one time when we were using steam locomotives in freight service, we were taking out from 2,000 to 2,500 freight wheels per month account overheating. The use of the freight diesel locomotive and the dynamic brake have reduced this approximately 75 per cent. The dynamic brake in passenger service has also brought about considerable savings on cross-country trains.

In the selection of locomotives for helper service, consideration should also be given to equipping locomotive with dynamic brakes to permit descent of grades at increased speeds without overheating the wheels when running light, and the use of locomotives having characteristics similar to locomotives which they will be helping.

As an example, a helper locomotive which has a lower continuous rating than the locomotive which it is helping cannot be fully utilized insofar as its hauling capacity is concerned, because the speed of the train must conform to the characteristics of the other locomotive; otherwise, it will result in damage to the electrical equipment. If the continuous rating of the helper locomotive occurs at a higher speed than the continuous rating of the locomotive it is helping, it will result in getting little benefit out of the helper, as the speed of the train must be maintained at a speed not below rating of helper engine. Generally, helper engines having similar power plants and gear ratios as engines they are helping can be best utilized.

Santa Fe Photo

Testing a 567 engine EMD fuel injector on a Buda test rack at Barstow.

In order to utilize the diesel locomotive fully, it is important that consideration be given to the ability of the locomotive to negotiate short distances at low speeds without overheating the traction motors; in other words, taking advantage of short-time ratings of traction motors.

It is important, however, that such tonnage ratings be carefully used and not abused; otherwise, it will result in overheating of the electrical equipment and expensive damage to the locomotive. While abuse of short-time tonnage ratings may not be immediately apparent in affecting the equipment, it will cause trouble at a later date. Wherever short-time ratings are used, it is necessary that the enginemen be carefully instructed and supervised to see that locomotives do not become abused.

DIESEL LOCOMOTIVE UNITS INSPECTED AT SAN BERNARDINO SHOP—12-MONTH PERIOD

	1951		1952										
Type of Work	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Totals
1 Yr. Ann. Insp.	24	26	16	15	17	19	9	16	19	11	10	..	182
2 Yr. Ann. Insp.	11	24	9	15	11	7	8	2	5	8	8	8	116
3 Yr. Ann. Insp.	13	5	3	1	11	20	25	24	8	22	23	42	197
4 Yr. Ann. Insp.	2	..	2	12	5	7	13	6	13	8	7	6	81
5 Yr. Ann. Insp.	12	6	..	4	8	1	..	3	3	2	2	..	41
6 Yr. Ann. Insp.	2	1	..	..	1	..	..	2	..	4	2	1	13
12 Yr. Ann. Insp.	..	..	..	..	..	..	1	..	..	..	..	..	1
(*) Misc. Work	1	3	5	4	3	6	2	4	8	1	2	5	44
I. C. C. Inspections:													
(a) Monthly	..	1	43	28	34	50	34	38	38	31	41	47	385
(b) Quarterly	..	..	11	12	10	1	15	8	12	11	2	2	84
(c) Semi-Annual	1	..	1	10	4	6	6	2	2	5	8	5	50
Totals	66	66	90	101	104	117	113	105	108	103	105	116	1194
(**) Wreck Repairs	2	1	..	..	2	1	1	10	3	5	1	..	26

Note: (*) Miscellaneous work includes units brought into shop between annual inspections for installation of test pistons, changeout of damaged traction motors; etc.

(**) Units receiving wreck repairs are included in the listing of annual inspections, it being understood they received maximum repair for class of service. (6-year annual inspection for Road Units, and 12-year annual inspection for switch units.)

DIESEL UNITS ASSIGNED TO SAN BERNARDINO SHOP FOR GENERAL REPAIRS

Class of Service	1951 Nov.	1951 Dec.	1952 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Average totals
(a) Switch	96	95	95	93	93	93	95	95	95	95	95	98	94.83
(b) Freight	395	393	393	393	385	385	394	395	385	393	393	396	390.83
(c) Passenger	178	178	178	178	178	178	178	178	178	178	179	204	180.25
Other system lines diesel units	1	..	..	..	3	7	7	1	..	..	..	..	1.58
Totals	669	666	666	664	659	663	674	659	658	666	667	698	667.49

Note: Other System Lines diesel units are units sent to San Bernardino Shop for wreck repairs, and are included only in totals for months they were released from the shop.

MAJOR ITEMS OF WORK PERFORMED AT SAN BERNARDINO SHOP—12-MONTH PERIOD

Type of Work	1951 Nov.	1951 Dec.	1952 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Totals
Trucks completely overhauled	128	126	129	102	114	128	121	113	105	125	111	145	1448
Number of cylinder assemblies changed	477	528	607	479	746	549	628	475	408	519	498	616	6530
Main engines changed	11	6	7	10	7	8	7	7	7	8	7	11	96
Main generators changed	9	8	6	11	9	5	10	10	6	9	3	14	90
Traction motors changed	256	255	258	204	228	257	245	231	218	256	223	293	2924
Diesel engines completely rebuilt	16	11	10	13	11	12	12	11	9	9	7	9	130
Cylinder liners	833	864	1108	1077	1359	1039	1096	948	771	1037	1109	1181	12,442
Pistons	567	626	689	599	824	676	687	538	524	623	601	714	7,668
Connecting rods	567	626	689	599	824	676	687	538	524	623	601	714	7,668
Cylinder heads	580	637	704	618	831	740	907	787	777	892	889	988	9,350
Cylinder head valves	1908	2112	2428	1916	2920	2004	3200	2392	2548	2764	3024	3360	30,576
Rocker arm assemblies	1277	1475	1697	1337	2088	1343	1634	1217	1077	1385	1387	1735	17,652
Unit-type fuel injectors	721	565	797	558	861	792	724	478	521	501	488	849	7,855
High-pressure fuel pumps	101	120	105	85	40	77	106	58	62	77	83	85	999
Fuel pump injector nozzles	413	397	447	383	401	468	405	345	483	335	554	656	5,287
Water pumps	48	53	50	48	48	47	37	45	31	30	35	46	518
Blowers (Engine air supply)	12	11	13	13	30	33	24	38	33	13	18	20	258
Radiator cooling cores	129	130	127	134	132	137	129	137	133	136	138	134	1,596
Oil cooler cores	14	15	21	18	17	22	23	26	24	25	27	24	256
Diesel engine lubricating oil pumps	14	12	16	15	15	17	23	17	17	22	19	23	210
Diesel engine governors	46	65	73	66	71	81	77	68	70	69	71	75	832
Fuel oil pumps	70	42	32	44	48	50	35	63	8	39	34	38	503
Air compressors	63	55	57	22	57	52	61	51	54	22	26	21	541
Air compressor intercoolers	71	66	70	68	66	69	57	61	65	69	67	68	797
Air compressor aftercoolers	68	64	70	69	67	65	59	60	67	71	70	68	798
Speed recorders	34	35	41	41	43	32	39	30	36	37	43	40	451
Trucks removed, completely overhauled and replaced	128	126	129	102	114	128	121	113	106	125	111	145	1,448
Diesel brake hangers modified	128	256	192	240	256	272	288	192	0	112	266	224	2,426
New driving wheels machined and mounted on axles (Pairs)	131	122	139	126	105	94	80	92	103	115	113	132	1,352
Driving wheels turned (Pairs)	238	242	261	194	217	255	232	236	197	234	224	105	2,635
Brake cylinders	520	452	584	412	468	484	476	422	470	416	398	480	5,582
Fuel oil filters and air and fuel gauges	975	985	1114	878	921	972	1014	841	929	866	926	1044	11,465
Main generators	13	10	9	13	16	9	15	11	9	12	8	17	142
Auxiliary generators	38	40	46	60	70	62	48	36	44	41	47	41	573
Traction motors	137	137	144	130	140	142	140	160	176	155	156	200	1,817
Auxiliary motors	234	170	167	218	205	133	216	178	252	255	275	344	2,647
Magnet valves, carnatherme, and arc chutes	202	184	157	162	182	169	246	180	178	149	195	172	2,176
Voltage regulators and governor controls	107	118	100	99	97	110	112	88	98	90	109	101	1,229
High and low voltage, control, and distribution panels	34	29	29	34	37	31	31	31	20	38	40	35	389
Cam switches and reversers	30	30	31	40	41	41	35	61	77	64	70	53	573
ATC and ITS receivers and amplifiers	35	30	45	30	45	48	40	40	38	40	45	30	466
Batteries	31	37	44	32	57	33	53	27	39	47	44	67	514
New traction motor armature shafts manufactured	0	0	0	0	2	8	12	10	8	0	0	0	40
Armature and miscellaneous shafts reclaimed by metal spray	58	42	40	50	30	69	52	64	40	55	41	64	605

Regarding grouping of similar types of power, there are four major diesel locomotive builders in the country and the locomotives built by each of these companies are considerably different insofar as design is concerned, and practically none of the parts are interchangeable.

In addition to this, each company itself builds more than one type locomotive. Whereas, in later years they have made many of the parts interchangeable between these locomotives, there are still quite a few which are not, and the majority of the locomotives which were built up until the last few years do not have any parts interchangeable with the present-day locomotives. Taking into consideration the fact that thousands of different parts are required to build a diesel locomotive, it becomes apparent that the material situation is a major problem, as it is necessary to have an adequate stock of spare parts on hand in order to keep the locomotives available all possible. When the operation and maintenance of locomotives of different manufacture are intermingled, it results in a tremendous storekeeping problem insofar as bookkeeping is concerned, and a huge increase in storehouse inventory.

The fact that locomotives of different manufacture must be operated in a different manner make it necessary that specific printed instructions and supervision be given for each of the various types.

For the reasons mentioned, it is wise to group similar locomotives all possible.

Proper facilities must be provided, both from the standpoint of expediting the work in order to maintain high availability and from the standpoint of having facilities to get the necessary work done. Whereas many completely new structures have been built for maintaining diesel locomotives, by the same token many existing structures have been remodeled for diesel work to advantage from the work standpoint, as well as financially.

It is important that a detailed maintenance schedule be established, placed in effect, and rigidly adhered to. In order to do this, it is necessary that the locomotives be worked back to the designated maintenance terminal at

the time they are due for detention. Consideration must be given to the ability of getting the locomotives to this terminal when selecting the site for it.

New diesel facilities are expensive, and considerable money is also required for remodeling existing facilities. For this reason, careful consideration should be given to eliminating present intermediate facilities all possible and concentrating the work in a minimum number of central locations. Most railroads were laid out for steam operation, with servicing facilities each 100 to 150 miles in order that engines could be relayed at each division point. Dieselization will allow the elimination of a greater portion of the existing facilities built for steam.

The complete elimination of all facilities not required for diesel operation. This includes water tanks, treating stations, pumping plants, filtering plants, coal chutes, crude oil tanks, and facilities for furnishing oil to the engines, as well as power plants, in many cases, which were necessary for heating and pumping the oil. The same applies to power plants which were necessary for pumping water. In many cases, complete roundhouses, as well as back shops, will be eliminated and the power plants necessary for their operation. In cases where existing roundhouses or back shop facilities are remodeled for diesel operation, it is still possible to eliminate a good share of the power plant equipment and modernize it with great resulting economy.

Instruction of Personnel

Instruction of road and shop personnel. The advent of the diesel locomotive has resulted in the need for intensive educational programs, for both the shop personnel and the enginemen operating the locomotives, and also for the persons supervising the work. Approximately half the equipment on the diesel locomotive is of an electrical nature; consequently, it has been necessary to stress that portion of the locomotive considerably and find ways and means to increase and educate the maintenance forces.

Due to the huge present-day demand for electricians, they are generally not available, and those who are available are not familiar with the diesel-electric locomotive. Consequently, it is usually necessary to educate existing personnel in order to get adequately trained workmen. Many roads have built instruction cars for both shop and road personnel, and these cars are moved from one territory to another and have been beneficial in the development of the educational program. The educational program changes on each railroad as additional diesel power is placed in service.

To begin with, it is usually necessary to start out mainly with fundamentals, gradually working into the detailed makeup of the various locomotives. Due to the fact that the locomotive builders are continually changing the design of the locomotive, it is necessary that the instruction program also be continually changed.

Because of the rapid dieselization which has taken place on the railroads in the past few years, there is a greater demand today for trained men than ever before, and in order to best meet the situation it appears that a well-planned, adequate apprentice program should be utilized for doing so.

Each type of locomotive has its own individual characteristics, which dictate as to the maintenance required, and unless such demands are met it will result in considerable expense and, in many cases, interruptions to

Santa Fe Photo

Opening water pump valve to steam generator—Barstow diesel shop.

the service. Maintenance schedules should be set up at proper intervals to meet the demands of the locomotives in the service and rigidly adhered to.

The shop personnel are responsible for performing the work when locomotives are in the terminal; however, it is not possible for this to be done unless the locomotives are on hand at the proper place at the designated time. One of the big problems in railroading has always been to have locomotives at maintenance terminals at the proper time so that they can be worked on. With dieselization it is more important than it ever was for steam that this be done.

There are various schemes of maintenance in service on the different railroads throughout the country today. However, regardless of any scheme which is placed in effect, it is necessary that there be complete co-operation between the mechanical and the operating departments for it to be successful. The matter lies primarily in the hands of the various foremen and chief dispatchers to see that the locomotives receive the attention they need.

Due to the many parts which go to make up a diesel locomotive, there are a large number of parts to repair. To repair many of these parts it is necessary to have special equipment and machinery. The locomotive manufacturers have programs in effect where it is possible either to send parts to them for repair and return, or exchange parts for those which have already been repaired. These programs have been convenient especially when railroads were first getting started in diesel operation; however, it generally results in increased cost.

Past experience on the Santa Fe has indicated that by providing the necessary facilities, tools, and machinery for repairing various locomotive parts, it has been possible to bring about very substantial savings. For this reason, careful consideration should be given to the nec-

MAN-HOURS WORKED BY SHOP CRAFTS ON DIESEL LOCOMOTIVES IN SAN BERNARDINO SHOPS—12-MONTH PERIOD

Date	Machinists	Electrician	Sheet metal workers	Boilermakers	Blacksmiths	Carmen	Laborers	Totals
November, 1951	55,675	31,722	11,816	7,393	964	7,965	2,384	117,919
December, 1951	51,670	29,596	11,452	6,794	943	6,993	2,223	109,671
January, 1952	59,196	33,717	12,714	8,506	1,542	7,956	9,368	132,999
February, 1952	53,864	30,327	11,637	7,931	1,026	7,722	7,896	120,403
March, 1952	56,334	31,039	12,262	8,125	1,268	7,953	7,963	124,943
April, 1952	57,687	33,262	12,905	8,475	743	8,159	8,131	129,363
May, 1952	54,841	31,368	12,605	7,179	864	7,906	8,173	122,938
June, 1952	55,665	32,219	12,469	7,427	1,339	8,179	8,800	126,098
July, 1952	58,112	34,022	13,007	7,850	1,576	8,111	8,674	131,353
August, 1952	55,123	31,586	11,893	7,078	1,046	8,226	7,997	122,948
September, 1952	55,620	32,030	12,204	8,080	1,299	8,106	8,469	125,867
October, 1952	62,623	34,956	14,032	8,366	1,333	8,921	8,827	139,059
Grand totals	676,412	385,845	149,056	93,204	13,943	96,196	88,905	1,503,563

COST OF DIESEL REPAIRS EXPRESSED ON A PERCENTAGE BASIS

	1947				1951			
Type of Service	Passenger	Freight	Yard	Total	Passenger	Freight	Yard	Total
Diesel engines								
Labor	37.49	47.23	48.63		24.65	35.73	37.15	
Material	33.13	45.45	49.03		33.75	25.12	48.89	
Total	35.39	46.49	48.86	42.51	29.09	31.20	42.72	32.26
Electrical equipment								
Labor	22.82	25.90	18.05		26.78	26.21	17.99	
Material	28.62	31.97	28.08		26.89	47.04	20.88	
Total	25.61	28.42	23.84	26.58	26.83	35.11	19.36	29.96
Other repairs								
Labor	39.69	26.87	33.32		48.57	38.06	44.86	
Material	38.19	22.58	22.88		39.36	27.84	30.23	
Total	39.00	25.09	27.29	30.91	44.08	33.69	37.92	37.78

Note: The original paper included similar data for years 1947–1951 inclusive. These were selected as typical—EDITOR.

RELATIVE COST OF REPAIRS, LUBRICANTS AND FUEL—THREE TYPICAL YEARS

Year	Type of Loco.	Repairs	Lubricants	Fuel	Total
1943	Switch	7.68	0.66	3.55	11.89
	Passenger	21.36	2.40	9.09	32.85
	Freight	27.09	7.10	21.07	55.26
	Total	56.13	10.16	33.71	100.00
1947	Switch	7.70	0.31	2.85	10.86
	Passenger	23.82	1.61	19.50	44.93
	Freight	21.17	1.55	21.49	44.21
	Total	52.69	3.47	43.84	100.00
1951	Switch	7.58	0.56	2.78	10.92
	Passenger	16.48	0.95	14.72	32.15
	Freight	25.61	1.73	29.59	56.93
	Total	49.67	3.24	47.09	100.00

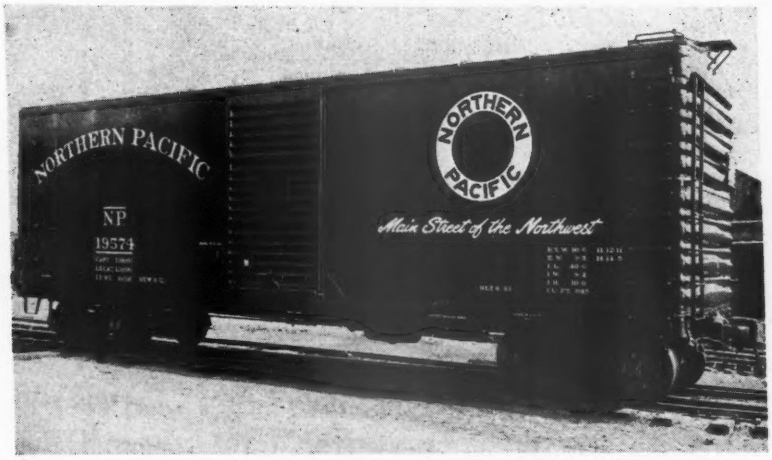
essary facilities and special tooling to do this work—at least, a good portion of it. In some cases it may be found, where expensive equipment is needed to make repairs, that it would be better to send the work to the manufacturer; however, generally speaking, the quantity of work involved will determine as to which method will result in the least cost.

The cost of new diesel locomotives is gradually increasing, as well as the cost of maintaining and operating existing ones, and as these locomotives become older there is every reason to believe that there will be a further increase in the repair costs, inasmuch as they will require certain heavy repairs which the majority of them have not had in the past, such as complete re-wiring of the locomotives and rewinding of main generators and traction motors. For this reason, it is important that further ways and means be developed to reduce repair costs.

Good locomotive performance does not just happen, but is brought about by the combined efforts and careful planning on the part of all concerned, all of which becomes apparent when the results are analyzed.

Frame being loaded on the trucks of a depressed-center flat car recently built at Topeka, Kan., shops of the Atchison, Topeka & Santa Fe. The completed car has a cast-steel underframe, 3-in. creosoted decking at both ends of upper portion of deck, six-wheel cast-steel trucks, wrought-steel wheels, straight-center solid axles with 6½-in. x 12-in. journals, AB brake equipment consisting of a separate cylinder and reservoir for each truck, drop-shaft type handbrake, bottom-operated Type E couplers, A.A.R. approved draft gears, and Timken roller bearings with grease lubrication. Capacity, 250,000 lb.; load limit 250,500 lb.; light weight 125,500 lb.; length, 57 ft. 9 in.; width over decking, 8 ft. The car is designed principally to handle such shipments as large transformers, etc., where weight, height and concentrated load are involved.

NP Box Cars Built in Record Time



THE Northern Pacific has recently completed building 1,000 50-ton box cars at the company shops, Brainerd, Minn. Originally planned for inclusion in the 1952 program, but delayed for lack of steel, work on these cars was started in April this year, production stepped up to 14 cars a day by June 1 and the order completed in the middle of July instead of August 1 as anticipated. Present plans call for the construction of 500 similar cars for the Spokane, Portland & Seattle as soon as necessary material is available. Sixty-two new cabooses also are on this year's building program at Brainerd shops.

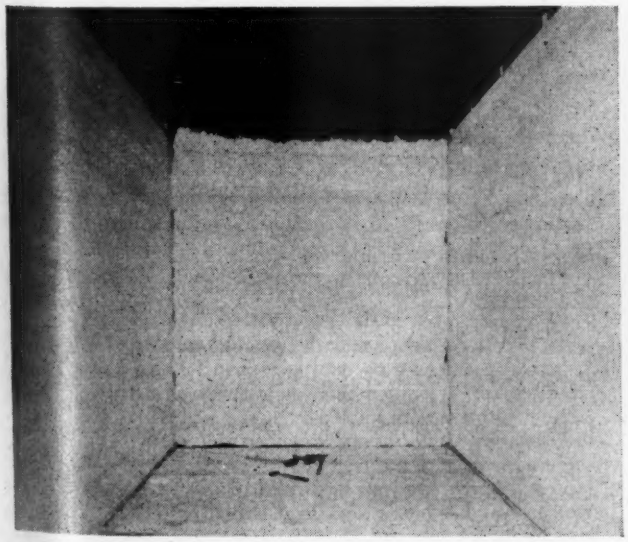
The general construction of these 50-ton box cars includes the following details common to all the latest NP equipment of this type: An 8-in. 21.4-lb. channel side sill reinforcement extending from end sill to end sill; Youngstown $\frac{5}{16}$-in. O.H.S. inside gusset and $\frac{1}{4}$-in. O.H.S. outside gusset at the door posts; three 3-in. 6.7-lb. Z-bar floor stringers on each side of the center sill.

This series of cars is also equipped with insulated ends, the insulation used being Fiberglas battens 2 in. thick, tacked to the end lining nailers before application of the end linings. These battens are held in place by nails passing through the end lining, insulation and into the nailing strips. This insulation is used primarily for the purpose of weevil and infestation control.

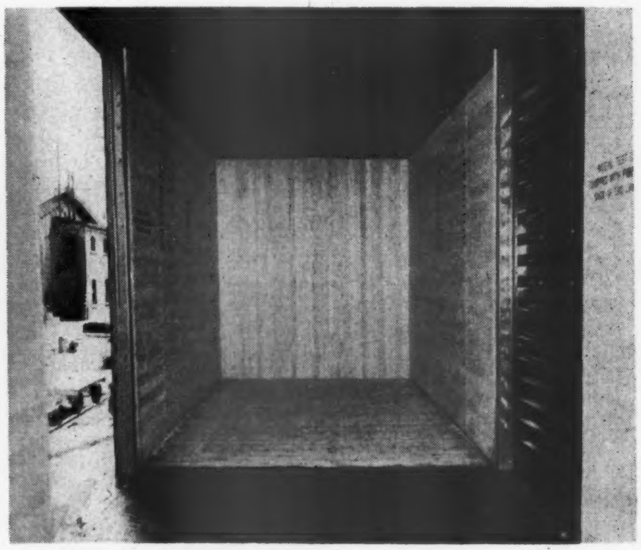
Another feature of interest is the floating brake lever fulcrum of the multi-hole type which provides up to 14 in. take-up. The foundation brake gear is designed so that the movement of the fulcrum pin one hole adjusts the piston travel one inch.

The car has the following general dimensions and weights: Inside length, 40 ft. 6 in.; inside width, 9 ft. 2 in.; inside height, 10 ft. 6 in. cubic capacity, 3,915 cu. ft.; light weight 45,500 lb., load limit 120,500 lb.

Extra floor stringers, steel sides and end in position.



How Fiberglas insulation is tacked to end lining nailers.



Car interior as finished ready for service.

ELECTRICAL SECTION

Flashovers—Causes and Remedies

Evidence collected by the Diesel Electrical Committee of the Locomotive Maintenance Officers Association points the way to necessary improvements in practice and design

ANOTHER step toward the elimination of flashovers on diesel electric locomotive generators and motors has been taken by the Diesel Electrical Committee of the Locomotive Maintenance Officers Association. A chart listing causes was provided to member railroads and the data collected, while not conclusive, indicates the most common causes and suggests how further study can be made most effective.

The report which was presented at the 1953 annual meeting of the Association, held in Chicago, during the week of September 14, states that in order to classify the many causes of flashover on diesel electric locomotives, it is first necessary to accept the premise that the actual flash is a leakage between brushholders of opposite polarity. The causes can then be stated as:

A. Unfavorable mechanical conditions at the commutator itself.

B. Voltage excessive for proper commutation.

C. Current excessive for proper commutation.

D. Electrical upset of neutral brush setting and electrical surges beyond commutating capacity by reason of sudden changes in armature current or abnormal field currents.

Following are all the causes which have been reported, along with their percentages of occurrence: (The symbol Tr. indicates Trace Percentage)

Unfavorable Mechanical Conditions at the Commutator

	Per Cent Generator	*Per Cent Motor*
1. Commutator out of round or flat	2	Tr.
2. Dirty commutator slots	10	—
3. Dirty string bands or risers	9	10
4. Improperly painted string bands or risers	2	—
5. Short brushes	Tr.	—
6. Broken brushes	—	Tr.
7. Broken brush shunts	—	1
8. Brush shunts rubbing risers	Tr.	—
9. Brushes sticking in holder due to oil	2	1
10. Brushes not seated	Tr.	Tr.
11. Improper grade of brush or mixture of brush on same commutator	Tr.	Tr.
12. Commutator raw (improper film; not broken in after stoning)	tr.	—
13. Brush holder to commutator clearance improper	Tr.	—
14. End ball loose and shifting brushes off of neutral polarity	Tr.	—
15. Loose generator to engine coupling	Tr.	—
16. Throttle not eased off while passing over railroad crossing	Tr.	Tr.
17. Water or oil on commutator as result of leaks from engine or faulty washing procedures	2	1
18. Locomotive run through high water	Tr.	Tr.
Total	29	16
Total all commutator conditions:		46

Voltage Excessive for Proper Commutation

	Per Cent of Occurrence
1. Forestalled forward transition because of:	
a. Improper operation of manually equipped unit	1
b. Automatic equipped unit leading a manually equipped unit and engineer improperly instructed	1
c. Forward transition relay improperly adjusted or settings not stable	3
d. Floating open circuits in transition control wires or interlocks	Tr.
2. Locomotive overspeed (Gear ratio too low for service)	3
3. Improper use of sanders and throttle causing repeated wheel slippage	2
4. Wheel slip relay not sufficiently sensitive and allowing uncontrolled wheel slippage	2
5. Wheel slip relay out of adjustment	Tr.
6. Dynamic brake blower motor overspeeded because of going into dynamic braking too quickly at high train speed	Tr.
	14

Current Excessive for Proper Commutation

	Per Cent of Occurrence
1. Forestalled backward transition because of:	
a. Improper operation of manually equipped unit	Tr
b. Automatic equipped unit leading a manually equipped unit and engineer improperly instructed	1
c. Engineer made mistake and shifted from position *2* to position *3* when he should have shifted from position *2* to position *1*	Tr.
d. Backward transition relay improperly adjusted or settings not stable	2
e. Flotating opens in transition control wires or interlocks	Tr.
2. Dynamic brake operated in overload	Tr.
3. Faulty dynamic brake field loop switch or switch improperly set	Tr.
4. Engine load controls set for excessive horsepower	1

5. Carbonized path between high voltage leads at clamp blocks inside generator, in generator pits, under floor plates or under locomotive 3
6. Carbononized path between contractors or terminal blocks along creepage surfaces in high voltage cabinets. (As resulting from cleaning compounds being splashed into cabinets) .... Tr.
7. Direct short circuit in high voltage system because of:
   a. Diesel engine water or oil leaking into high voltage equipment .... Tr.
   b. Insulation chafed and worn at inaccessible locations 2
   c. Foreign material in generator, motors or high voltage cabinet such as welding wire, flashlights, fuses, bolts, portable tools, etc. 1
   d. Broken banding wires .... Tr.
8. Unusual grounds in high voltage circuit at opposite polarity (example: conrol air hose rubbing against contractor stud and wearing through to metal braid of hose) .... Tr.
9. Snow or rain leaking into equipment causing dual leakage grounds and ground relay knife switch then being left open to keep locomotive running ...... Tr.

— 15

Electrical Upset of Neutral Brush and Electrical Surges Beyond Ability of Machine to Commutate

	Per Cent of Occurrence
1. a. Grounded or open generator armature	3
b. Grounded or open generator fields	2
c. Floating shorts or grounds in generator leads	3
2. a. Grounded or open motor armature	5
b. Grounded or open motor fields	Tr.
c. Flotating shorts or grounds in motor leads	1
3. Throttle shut off too fast while on heavy pull	2
4. Control air pressure low and allowing main contactors to open under load	Tr.
5. Loose connections in control jumpers or receptacles allowing main contactors to open under load	2
6. Leads burned open in high voltage circuit	2
7. Open shunt field discharge resistor or loose connections to same	1
8. Shunt field discharge resistor miswired with two standard resistor tubes wired in series instead of parallel	Tr.
9. Loose shunt field resistor wire	Tr.
10. Load regulator commutator burning or loose connections in lead regulator resistor banks	1
11. Carbonized path between field leads at clamping blocks at bottom of generator	2
12. Reversing locomotive while moving in opposite direction	Tr.
Total	25

Conclusions

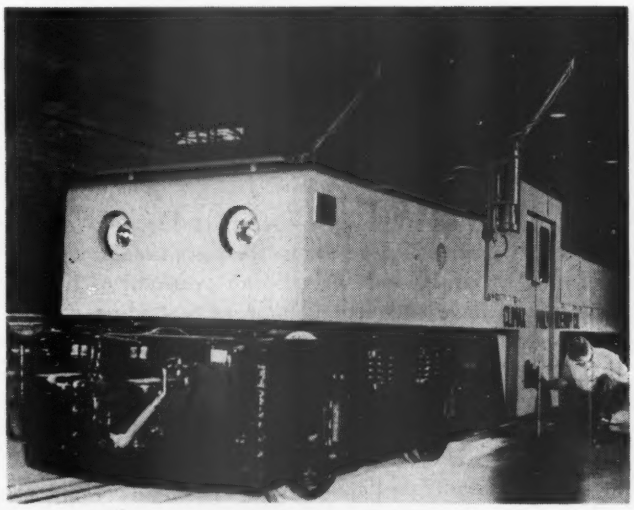
There is no single solution to the flashover problem. Corrections for each of the individual causes enumerated in the study are self evident in most cases. Some of the broader solutions felt to be necessary by individual railroads, as applying to their operating conditions only, are such things as conversion from five relay to three relay automatic transition, checking for commutator out of round condition at each wheel change, proper instruction of enginemen, more cleanliness, etc. A few large roads which have generally damp weather conditions feel an acute need for better control of high speed wheel slippage.

It is recommended that any road having difficulty should institute a program of careful checking of individual flashover cases and keeping a detailed record of each case.

Two very important matters are revealed by the study. One is the need for more careful and painstaking electrical maintenance. Diesel locomotive electrical equipment in the more recent models is very heavily loaded as compared to the locomotives of four or five years ago. It is loaded to a fantastic degree when compared to stationary motors and generators. The Committee recognizes that relatively few mechanics understand the sensitivity of commutation under these highly loaded conditions. For example, it is believed that one of our most difficult tasks is training a man who is accustomed to seeing turntable motors and stoker motors operating under oily and dirty conditions without ill effect and convincing him that these conditions cannot be tolerated on a diesel. In this connection, the manufacturers have a responsibility to design the equipment so that engine rooms can be easily washed without water getting into the electricals and particularly so that wiring and connections are properly accessible without unending labor. This is the other important matter which is revealed by the study. The cases in which nearly inaccessible pit wiring defects are involved total up to 20 per cent of all the various flashover causes. There is an imperative need for top-connected main generators on new power and for the development of top or side connect conversions to be made on old power at the time of locomotive rewiring. There must be no wires near the natural dirt collecting sub-flooring level except those having to make one pass through the floor to the traction motors.

It can be expected that manufacturers will continue development of flashover inhibiting devices for reducing the extent of flashover damage when they do occur. However, the room for real improvement is in more aggressive and careful maintenance along with design clean up of wiring and switch gear layout.

W. P. Miller, assistant superintendent motive power—diesels, Chicago and North Western, is chairman of the Diesel Electrical Committee, Locomotive Maintenance Officers Association.



To overcome clearance limitations in a mine of the Climax Molybdenum Company, the General Electric Company designed an all-electric locomotive with an overall height of only six feet, eight inches. It is one of seven which will be used in the Climax, Colo., mines at an altitude of more than 11,000 ft. above sea level, will do hauling in connection with a new mining project to develop a body of low-grade molybdenum ore. To meet the low mine clearance and still provide comfort for the operator, G.E. engineers employed a drop-center cab which clears the rails by only eight inches.

General view of the motor and generator shop.

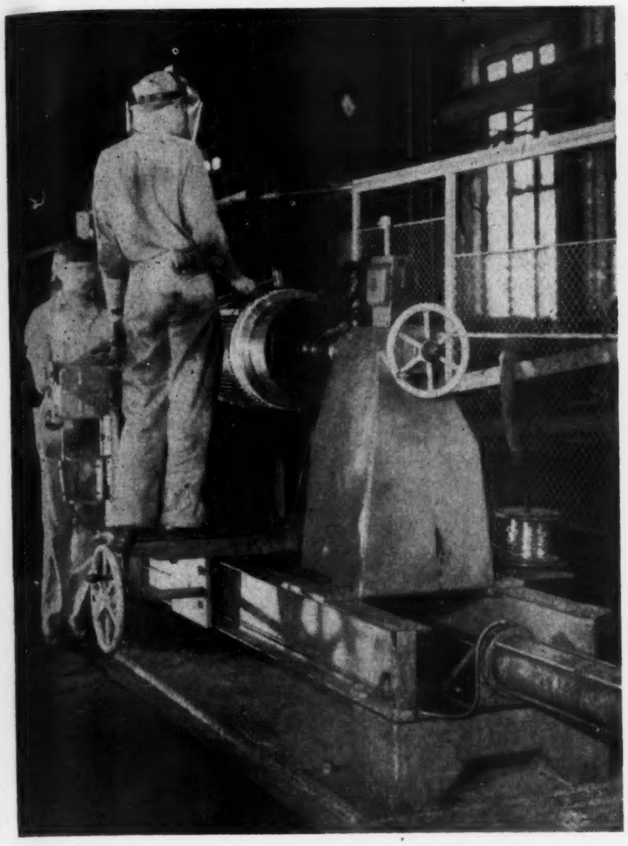
Rewinding In the Medium-Sized Shop

Central of Georgia with 124 locomotive units finds rewinding of diesel-electric traction motors and generators practicable since all road power goes through Macon, Ga., where the shops are located

A RAILROAD with 124 diesel-electric locomotive units has found that it is able to justify the purchase and installation of equipment for mileage overhaul of traction motors and have sufficient volume of rewinding work to justify equipment for this work. It is a recognized fact that the ability of a shop of this size to perform its own work, depends to a considerable extent, on the resourcefulness of its supervisors and employees. Large expenditures can be avoided by using existing buildings formerly used for steam locomotives and by converting machine tools which had been used in steam locomotive maintenance.

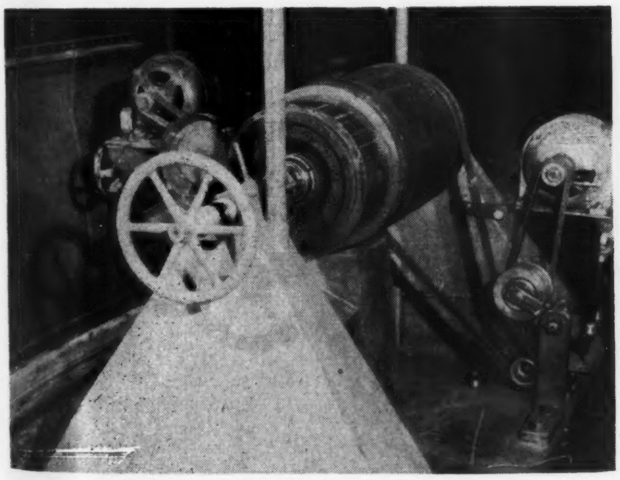
The Central of Georgia has developed diesel maintenance facilities at Macon, Ga., where it has shops formerly used for steam locomotive maintenance which are in good condition, have good crane service and are large enough to meet diesel maintenance requirements for some time to come. It was decided that the railroad would rewind traction motors and generators since all road power goes through and is serviced at Macon. Because of this, motor and generator overhaul and rewinding involves no shipping charges to and from changeout points or between Macon and outside motor service plants.

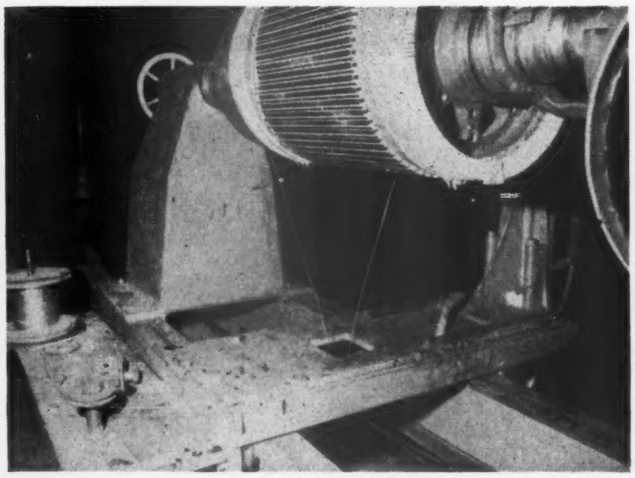
The road owns 520 traction motors, 496 of which are on its 124 locomotive units. It also has 12 additional spare traction motor armatures. There are 124 generators on the locomotives and there are three complete spare generators and two spare generator armatures to provide for emergencies, and to allow for shop time. Men who make daily, monthly and annual inspections and do running repair work also operate the motor shop. In this way a good average load factor is maintained and there are a minimum of overloads or slack periods. A few



Shop-built armature machine. Banding wire is applied from reel at right through tension blocks. After the wire is applied, it is looped and rerolled with tension supplied from the air cylinder shown in the foreground.

Below: The shop-built cutting and stripping machine.





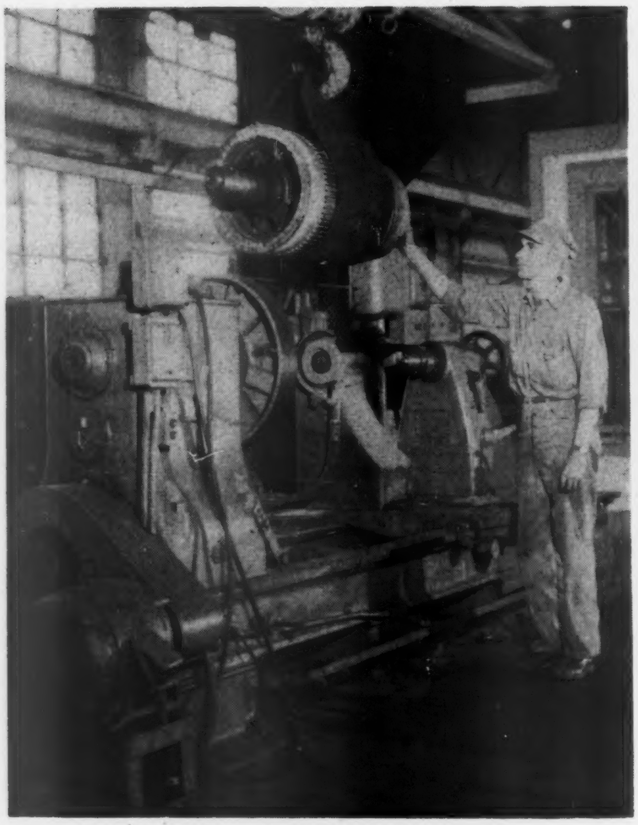
Back view of the armature machine showing how temporary banding wires are run over the armature and the tensioning device.

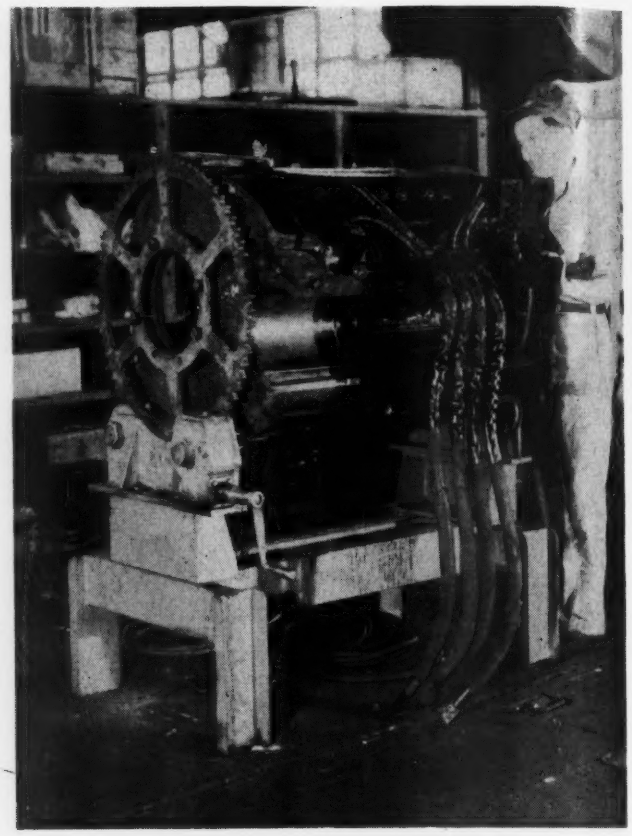
Below: Rear view of the stripping machine showing how an abrasive wheel is used for cutting the coils back of the risers.

rewind jobs are sent out when the work on hand exceeds the capacity of the shop.

Principal Pieces of Equipment Used in Shop

- 2 Young Brothers baking ovens
- 1 Struthers Wells vacuum impregnator with 2 tanks, one large enough for generator frames
- 1 Detrex vapor degreaser using perchlorethylene
- 1 Magnus Agidip for cleaning bearings
- 2 Armature machines—1 Peerless and one shop-made with device for rerolling
- 2 Undercutting machines—1 Peerless and one shop-made
- 1 Brazing tongs and transformer used both for back armature connection and field-coil terminals
- 1 Hand-operated 60-ton press for application and removal of bearings and field poles
- 1 Wheel press for removing and replacing shafts
- 1 Shop-made cutting and stripping machine
- 1 Globe Tool and Engineering Company armature balancing machine
- 3 High-potential testing machines—two for the motor shop and one for general shop purposes
- 1 Motor-generator set for run-in tests
- 4 Shop-built field frame positioners
- 6 Shop-built armature stands





Above, left: Armature being placed in the Peerless armature machine.

Above, right: One of the four motor frame positioners.

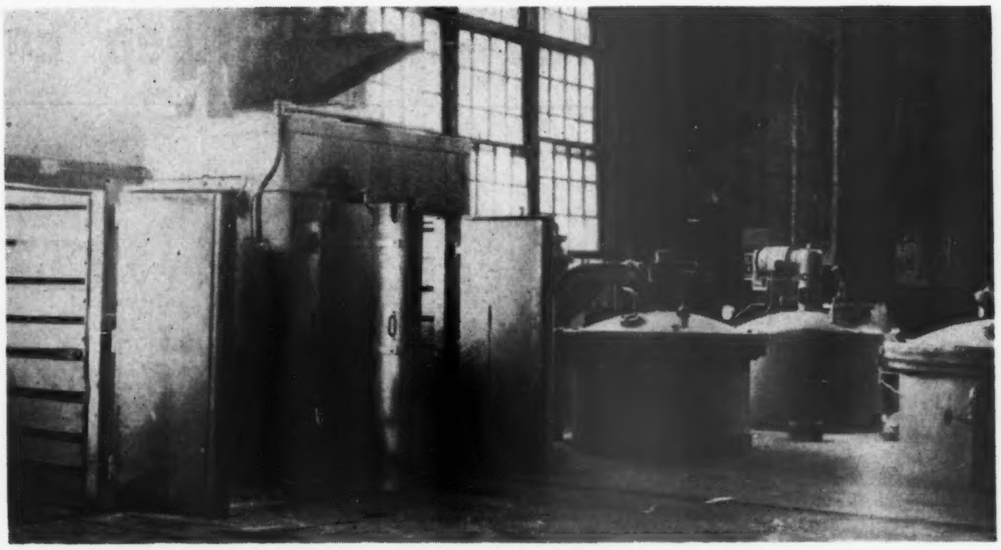
Left: Transformer and brazing tongs being used to braze field connections. The same transformer with different tong tips is used to braze armature back connections.

Below: The armature balancing machine in service.

1 Armature rack for six armatures
1 Soft-abrasive or grit-cleaning outfit will be installed
Meters, special tools and gages, miscellaneous hand tools and devices

The main section of the shop is 150 ft. long and 45 ft. wide. It is served by a $7\frac{1}{2}$-ton, floor-operated, overhead crane and three jib hoists. The section of the shop which includes the ovens, the degreaser, the impregnator

Ovens and impregnator. The extra tank at the right is large enough to take generator frames.



and motor and generator storage space is 60 ft. long and 60 ft. wide, and is served by a 20-ton crane, which also performs other duties, and a fork-lift truck which serves both sections of the electrical shop and moves work from one section of the shop to the other.

Procedure

When a traction motor is brought in for basic overhaul, the first operation is to remove the pinion. The frame is scraped to remove caked grease and mud, and avoid loading the degreaser with heavy dirt. Next the armature is removed from the field and stripped of its bearings. A light, shop-fabricated rack is used to lower the bearings into the degreaser.

The traction motor is cleaned by lowering the armature into the degreaser for three minutes and the field, with coils in place, for seven minutes. Upon removal from the degreaser, they are allowed to dry in an oven for 8 hours at 250 deg. F. They are then removed, allowed to cool on the cooling table to a temperature between 70 and 100 deg. F., and are then cleaned with air and wire brushes. This is followed by a one-minute high-potential test at 1,200 volts after which they are placed in the impregnator.

Pressure in the impregnator is reduced to 20-in. Hg., while varnish is flowed over the windings, leaving the commutators above the liquid. A vacuum of 20- to 28-in. is maintained for 90 minutes to exhaust any air pockets in the coils. Then CO_2 gas is admitted and held at a pressure of 90 lb. for 2 hr. to drive the varnish into the windings after which the pressure is used to return the varnish to the storage tank. The impregnated parts are then allowed to drain under a 25-in. to 28-in. vacuum for one hour when they are removed from the impregnator and all machined surfaces cleaned with mineral spirits. They are then placed in a baking oven in which the air is circulated at 295 deg. F. for 16 hr.

While the armatures are being reconditioned, the bearings and associated parts are cleaned in an Agidip for polished parts with Magnus 755 cleaner and neutralized with water in a shop-fabricated vat. The bearings are then blown dry with air and inspected under a magnifying glass. Those which pass inspection are stored in rust preventative and VFL paper.

After the curing process, the armatures are placed in the armature machine, undercut $\frac{3}{32}$ in. and ground. The armature is then tested for internal shorts and opens and painted with air drying varnish before balancing. Soft steel strips $\frac{1}{4}$-in. by 1-in. welded to the inner perimeter of the V-ring are used for armature balancing. The motor fields are also painted with air-drying varnish before reassemblying. All brush rigging is completely overhauled. After the motor is reassembled, it is given a final high-potential test for 1 min. at 1,500 volts.

Reconditioning of a main generator follows the same general procedure.

Rewinding

The armature to be rewound is placed in the armature machine and all bands are removed with the undercutting attachment. It is then moved to the shop-made stripping machine and an abrasive wheel is used to cut through all coils about $1\frac{1}{2}$ in. behind the commutator risers. The ends of the cut coils are pried up and an electric hoist and come-along are used to lift out first the top and then the bottom coils. The wedges come out with the top coils.

Next the armature is degreased (for three min. only) and all slots are cleaned with an 8-in. sanding disc and a motor-driven file. The commutator risers are not opened until the armature is ready for rewinding.

After the coils are in place, a shop-fabricated reroll machine is used for applying and rerolling temporary armature bands to pull down the coils. These are applied over rectangular steel "sticks" placed in the slots on the coils before the wedges are driven. A part of the temporary bands are left on when the permanent bands are applied with the same machine.

The back-end connections of the armature coils are silver soldered with a transformer and shop-fabricated welding tongs. The same tongs are used to braze field connections.

When the commutator is soldered, the flame-heated soldering iron is "boosted" by preheating the commutator. This is done by winding 15 turns of Nichrome resistance wire over mica on the surface of the commutator close to the risers and held in place by asbestos tape. Direct current at 220 volts is used for power.

DIESEL-ELECTRICS—How to Keep 'Em Rolling

20 Batteries and Battery Charging

What happens inside a diesel locomotive battery and what you have to do to make it work well and last long

REMEMBER the old fashioned wood burning stove? When you wanted to start a fire you laid in some paper and shavings. Then you put on some kindling and you were ready for the match. Without that the whole business was dead and worthless. In one way a diesel-electric locomotive is like the old stove. Unless you can get the engine running, it isn't worth anything. The locomotive battery cranks the engine and gets it going. It is the "match" that does the trick.

Some folks think batteries store electricity. Actually they don't—they convert chemical energy into electrical energy. To do this, they contain unlike metals and chemicals in a sort of "armed truce" condition. These are so eager to do battle that a voltage exists between the battery to a circuit, you get a flow of current. This ends the "truce" and the chemicals go to work on the metals. The heavier the current, the fiercer the attach, and the shorter the time before the battery is "dead."

As you know, there are two kinds of batteries. The first you use just once, and then throw them away. These are primary batteries. A good example is a flashlight battery. It is usually called a dry cell battery. Actually, it is a sealed can filled with a moist chemical paste.

The second kind can be recharged after it has been used. You can discharge and charge it many times before it finally wears out. This is called a secondary or storage battery, and is the kind you have on your diesels.

Strictly speaking, a battery consists of a number of cells connected together to give the voltage and current you want. For instance, the "batteries" for your flashlight are really cells. You put as many into the case as you need to form the battery.

Primary batteries have their cells connected in series—never in parallel. You might get away with a parallel connection while you have load on the battery. The new cells with the higher voltage will furnish most of the load. The old cells with the lower voltage will loaf. But when the load is removed, the cells with the higher voltage will discharge into those with the lower voltage.

This is the twentieth of a series of articles on the maintenance of diesel-electric equipment. This article is written by M. D. Henshaw and B. L. Judy, Locomotive and Car Equipment Department, General Electric Company, Erie, Pa.

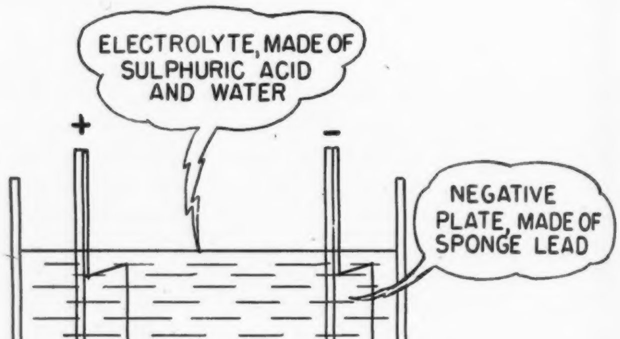


Fig. 1—Simple lead-acid cell

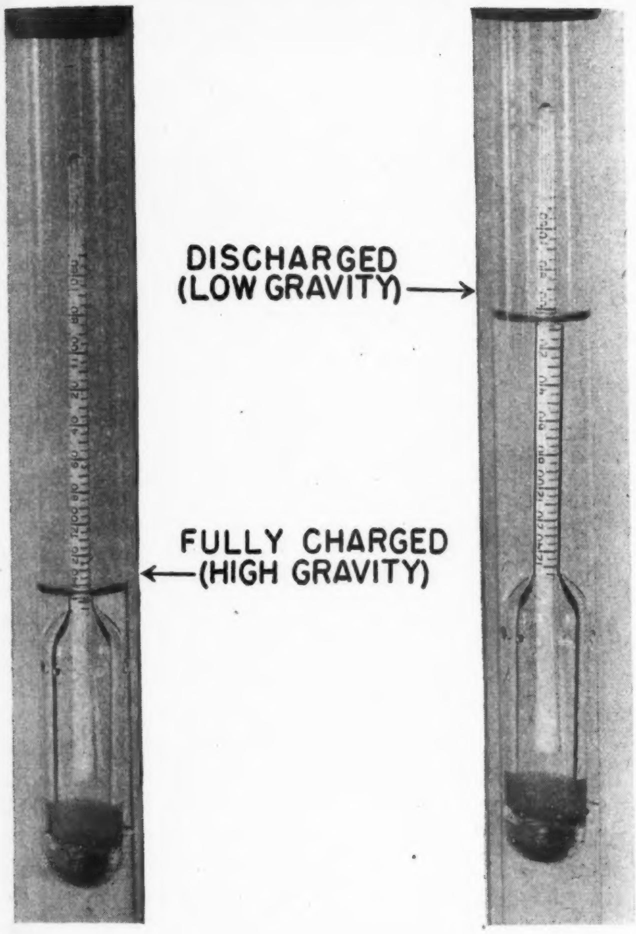
Soon the higher cells will drop to the lower level, and your battery has lost some of its capacity.

If you are working with secondary (storage) batteries, less harm will be done because you can recharge them.

How big is a battery? What's its capacity? How do you pick the right size for the job? Well, you wouldn't try to crank a diesel engine with your flashlight battery. Neither would you lug your auto battery around all day just to work your flashlight. So the answers to these questions boil down to something like this. Generally you need big batteries to handle big jobs, and little batteries for little jobs. Your battery must have enough cells to give the voltage you want under load. Each cell must be big enough to give the current you want, and to keep giving it as long as needed.

Batteries are something like sprinters. They can give bursts of power, but they need time in between to "catch their breath." If you hold a heavy load on a battery continuously, it will run down much more quickly than if the load is intermittent.

When a storage battery is discharged, you can recharge it by pumping an electric current back through



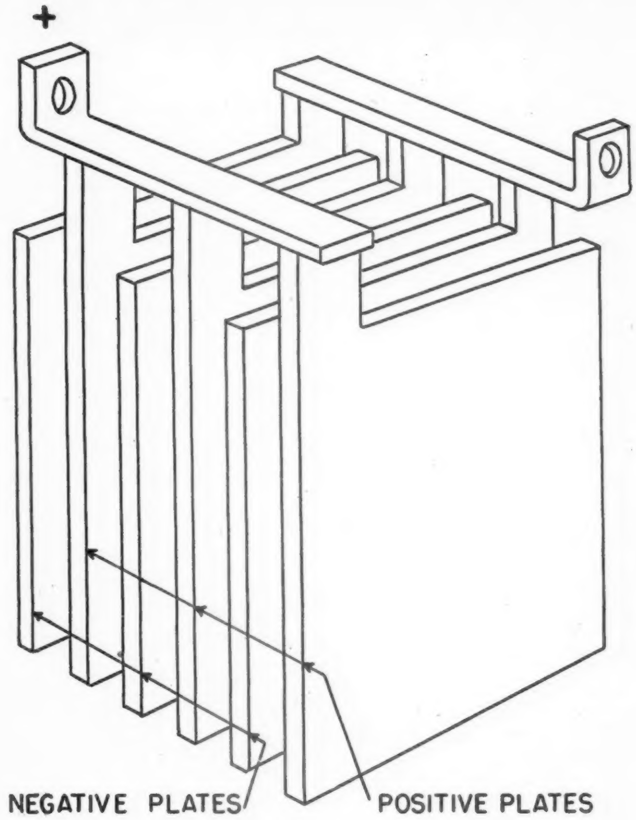


Fig. 2 (left)—Hydrometer reading shows state of battery charge. Fig. 3 (above)—The capacity of a cell is increased by nesting several positive and negative plates.

it. This restores the chemical energy to its original level.

Three types of storage batteries are in use today. They are named for the chemicals and metals they contain. First is the lead-acid type; second is the nickel-alkaline type; and third is the nickel-cadmium type. Each has its advantages and its weak points. Hence each type fits certain jobs best.

The most widely used storage battery is the lead-acid type, like the one in your car. You find it on most diesels because it can give very heavy currents for cranking the

Fig. 4—Cutaway views of two widely used makes of locomotive batteries.

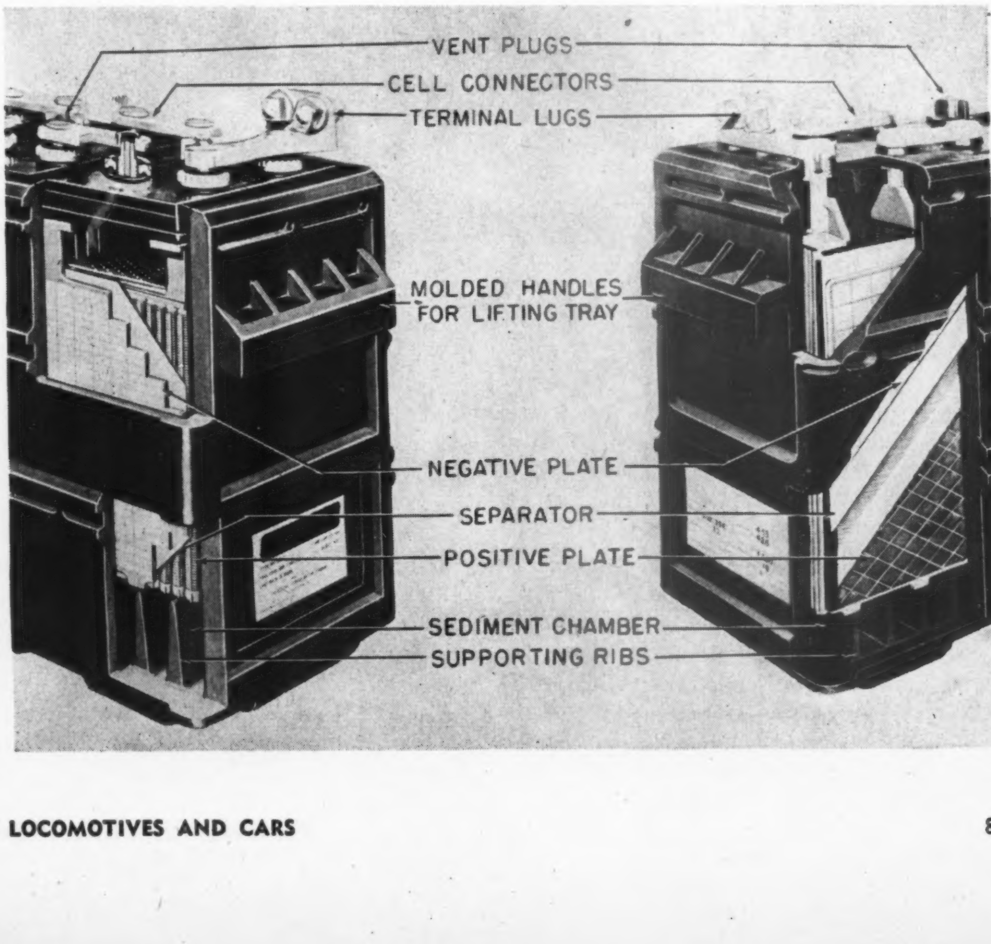


Fig. 5—When lifting a battery be sure to use the handles at the ends of the tray. If a crane sling is used, it should be rope so it won't short circuit the terminals.

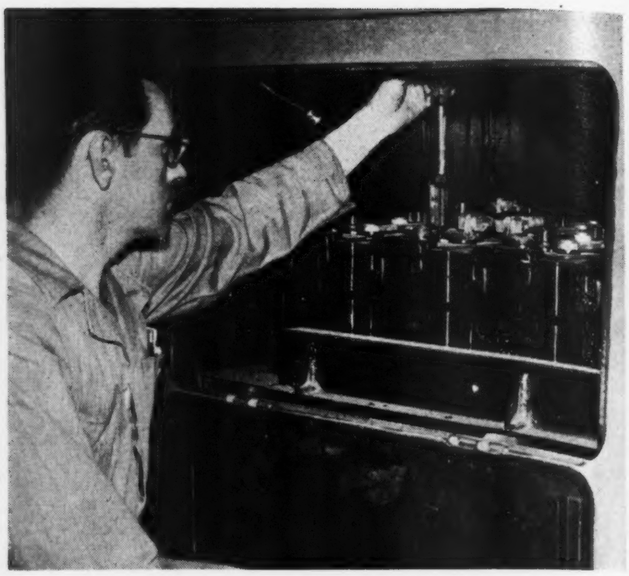


Fig. 6—Regular hydrometer readings serve as a running check on battery charge.

engines. Its cost is reasonably low also, but the weight is considerable.

Lead-Acid Batteries—How They Work

The chemistry of a lead-acid battery is pretty complex. We'll not get into that, but just take a quick look at what happens when a battery is charged and discharged. The parts we will consider are sketched in Fig. 1. They are: (1) the positive plate, which is a lead grid filled with lead peroxide paste; (2) the negative plate—also a lead framework but filled with porous or "sponge" lead; and (3) a solution of sulphuric acid and water, called the electrolyte. Let's start with a fully charged battery.

As has been said, there is a "truce" between these metals and chemicals. If we put a load on the battery, the truce is broken, and the chemical action causes current to flow. The acid attacks the lead oxide on the positive plate. As it is used up, a new compound: lead sulphate, commonly called "sulphate," is formed. Sulphate also starts to form on the negative plate. In making this attack, the acid also suffers. Part of it is used up, and water takes its place. If the load is left on long enough, almost all the lead oxide will be used up. Both plates will be loaded with sulphate. The acid won't all be used up, but it will be quite weak.

Suppose we connect a charging generator to the battery and force a current back through it. Now things begin to happen in reverse. The sulphate on the negative plate goes back into solution, leaving sponge lead. That on the positive plate is replaced by lead oxide. Sulphuric acid is formed by the sulphate going back into solution. This causes the acid solution to get stronger.

A handy way to remember the cycle is this—discharging uses up lead oxide and acid; charging restores them.

A word about gravity. Water has a gravity of 1.000. Concentrated sulphuric acid has a gravity of 1.834. In other words, acid is about 1.8 times as heavy as water. If you mix the two, the gravity of the solution will be somewhere between 1.000 and 1.834, depending on how much acid it contains. The more acid there is, the higher the gravity will be. We have seen that the acid solution in a charged battery is strong (high gravity) while in a discharged battery it is weak (low gravity). So by measuring the gravity of the solution you can tell the state of charge of the battery. To do this, you suck some of the solution into a hydrometer, Fig. 2, and see how low or how high the float rises.

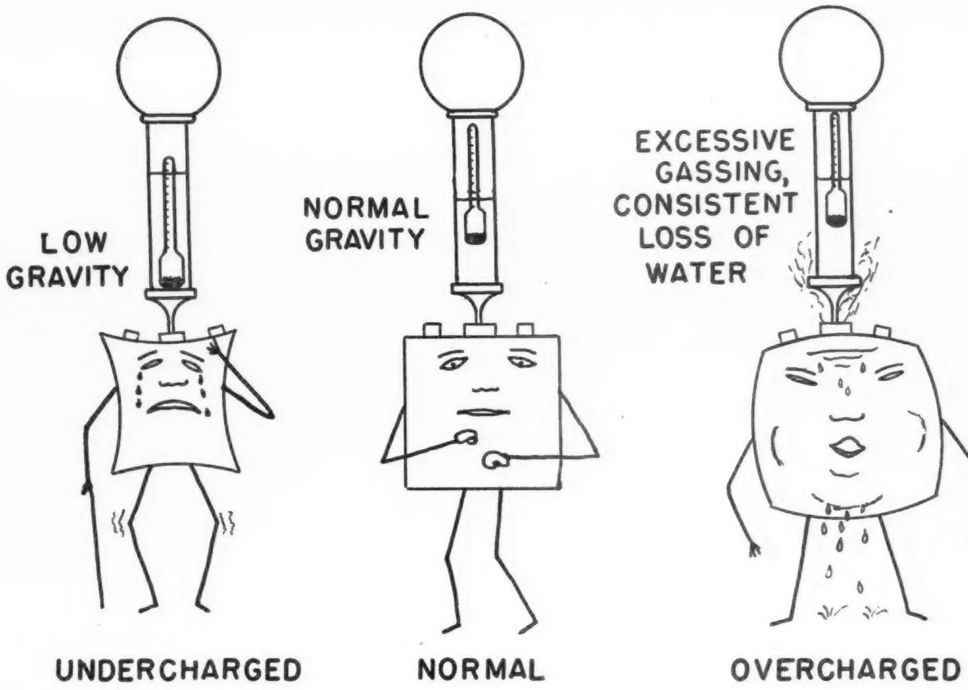
When a battery is fully charged there is almost no sulfate left to be converted into acid. If you keep on trying to charge such a battery, part of the water will be broken down to form gases, which will bubble out of the solution. This is called gassing. Charging beyond the "gassing point" uses excessive water. It is also hard on the battery and dangerous because hydrogen—one of the gases formed—is highly explosive.

Battery Construction

Batteries as built today differ greatly from the simple cell of Fig. 1. Several positive and negative plates are nested as shown in Fig. 3. Separators, made of wood, rubber, or any suitable porous material, are used to keep the plates from touching. In this way a lot of battery can be packed into a single cell.

Lead alloys are used to give greater strength to the plates. The negative plate is cased in a sort of skeleton grid shape. The active material is sponge lead which sticks to the plate very well. The problem with the positive plate is tougher. The active material is lead oxide, of a chocolate brown color. The lead plate and the oxide are not very good friends. The paste tends to crumble out and fall to the bottom of the cells. Different styles of positive plates have been designed to overcome this

Fig. 7 — Proper charging is essential to good battery health.



trouble. Two makes of batteries largely used in locomotive service are shown in Fig. 4.

Deep ribs are put in the bottom of all cell jars. These hold the plates off the bottom so that any paste that drops to the bottom will not short circuit them. The tops of the positive and negative plates are joined separately by lead strip connectors. These come out through the cell top as connector posts. A hard rubber cell cover is put on and sealed with asphalt compound. A vent is fitted into the top. The vent cap can be removed for adding water or measuring the gravity of the electrolyte. Small vent holes in the cap let out any gas generated during charging.

Lead-Acid Battery Characteristics

A fully charged cell has about 2 volts between terminals on open circuit. The voltage of a cell, like any electric generator, drops with load. It may go as low as 1 volt while cranking the engine. That's what makes the lights on your car go dim when you step on the starter. This drop is worse if the cell is partly discharged. When it is nearly discharged, there isn't enough voltage left to give the needed cranking current.

When you recharge a cell, you need more than 2 volts. The charging system on a locomotive uses about 2.32 volts per cell. With this value the charging current may be as much as 200 amperes when the cell is nearly discharged. As the charge comes up, the current gradually tapers off to 5 amperes or less.

Early diesel-electric locomotives had 16-cell batteries, like the railroad car lighting systems. As the diesel engines got bigger, this was not enough voltage to give the heavy cranking currents needed. So the battery was doubled, giving the present 32-cell, 64-volt system.

To charge this battery you have to set the voltage regulator for 32 x 2.32 volts, or 74 volts. This may vary some according to the weather. When it is hot, you may have to cut the voltage down a little to keep from gassing the cells. In the cold weather, you may have to set it up a bit. Since the locomotive charging system works at all engine speeds—even idling—you never have to change the setting much. You seldom will go below 72 volts and never above 76 volts.

The cells of locomotive batteries are pretty heavy. For this reason, four cells are usually assembled in a single tray. This can be lifted by two men or a small fork truck, Fig. 5. A careful maintainer will never hook onto the connection straps, terminal posts, or cables to lift a tray. That's like someone lifting a man by the hair. It strains the straps and posts, and may even break the cell tops. The battery should be lifted by the handles or lifts on the trays.

The capacity of a storage battery is based on a continuous discharge rate. This is usually the maximum current you can get from it continuously for eight hours. This current multiplied by eight hours gives the ampere-hour rating of the battery. For instance, many switchers use a 280 ampere hour battery. This will discharge 35 amperes for 8 hours. Batteries on road locomotives sometimes rate as much as 424 amp.-hours. These will discharge 53 amperes for 8 hours. The ampere-hour rating is stamped on the battery nameplate.

Of course, the capacity is less when you apply a heavy load. For example, if it takes 900 amperes to crank the engine on a road locomotive, you might expect a 450 amp.-hr. battery to do the job for half an hour. Actually, the battery will probably be dead after 10 or 15 minutes of cranking.

Like any piece of equipment, a battery is not 100 per cent efficient. This means you have to put in more ampere hours on charge than you get out on discharge.

Battery Care

We all know how important it is to keep electric equipment clean. The battery is no exception. Check the cell tops regularly. If they are dirty, clean them. It's a good idea to clean the battery and compartment by blowing with an air hose at regular intervals. At times you may

want to use a water spray under moderate pressure to wash away oil and acid-soaked dirt. Then blow out with an air hose. A solution of one pound of baking soda to one gallon of water is very good. It can be sprayed over the top of the battery with an air gun. This is an easy and quick way to neutralize acid that may have been spilled on the top. Be sure all vent plugs are in place, so the soda solution does not get into the cells.

Bolted connections should be protected from corrosion by vaseline or battery grease. It is best to apply the grease before the connection is made. Be sure the surfaces are clean and free from oxide. When you tighten up the connection, the grease will squeeze out. This seals the edges to prevent acid or air from getting in and causing a high-resistance joint to develop. Grease on lead parts or rubber-covered cable does no good and only collects dirt.

Batteries, like human beings, need water—clean, pure water. Be as careful about your battery water as you are about your drinking water. Some waters contain chemical impurities that make batteries "sick." When in doubt, use only distilled water. To keep it pure, avoid metal containers. Use a glass jar or bottle to carry what you need.

In many localities drinking water is pure enough to use in batteries. You may have local instructions regarding this. If you are not sure, have the battery manufacturer analyze a sample. Of course, you must still avoid handling the water in metal containers.

Some find it helpful to keep a record of the water consumption on each locomotive. When this shows that the battery on a certain locomotive is using more water than others of the same kind, the charging voltage may be too high.

When the water level is about a quarter inch above the plates, it's time to add water. But don't add so much that the level comes up to the bottoms of the vent tubes. If you do, it will overflow when the battery warms up and makes a mess on the cell tops. Filling within a quarter of an inch of the vent tubes is enough.

Another thing to watch—when the temperature is much below freezing—don't add water unless you have the battery on charge. Otherwise, the layer of fresh water may freeze before it can get mixed with the solution.

As we already know, the charge of a battery is shown by its gravity. It is a good idea to check this at regular intervals, Fig. 6. The job is easy if you select one cell in each tray. Keep a record of your readings, and then you can tell the effect of any changes you may have made in the regulator. The top gravity reading for most batteries is stamped on the nameplate. This will tell you what the fully charged reading should be. If possible, use a hydrometer with built in temperature correction scales.

Battery Charging

The battery charging system used on diesel-electric locomotives is very simple, yet one of the best there is. It works automatically whenever the engine is running, and charges at any engine speed. Another chapter explains how it works.

Most locomotives have a voltmeter connected across the battery, and an ammeter showing the charging current. A glance at these can tell you just what is going on. Suppose the ammeter shows zero or discharge and the voltmeter shows 64 volts or less. You know the auxiliary generator is not charging the battery. So you'll look for a blown fuse, a tripped breaker, a voltage regulator not working, or a broken wire.

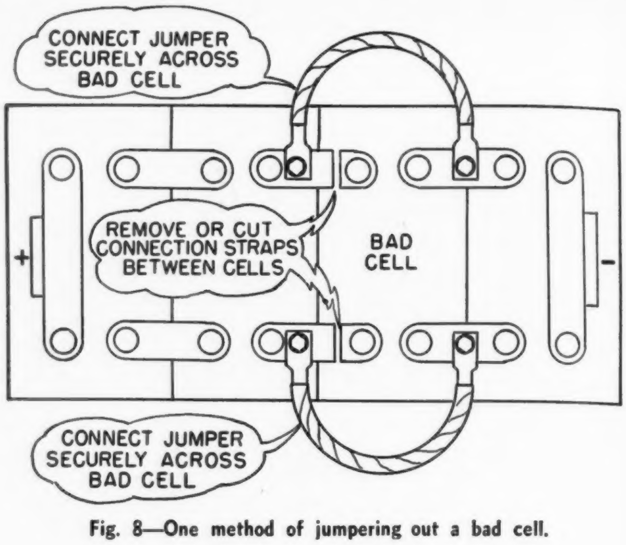


Fig. 8—One method of jumpering out a bad cell.

If the voltmeter shows 74 while the ammeter shows zero or very little charge, things are okay and the battery is charged. But if the voltmeter shows 70 or less, and the ammeter shows a heavy current—say 100 amp. or more—you have a low battery. In that case, you'd better let the engine idle for a few hours to get the battery gravity up where it belongs.

Just how much should you trust the locomotive instruments? Not too much. They take quite a beating, and may not give an accurate reading. Usually, they are close enough to tell whether the battery is being charged and whether the voltage is somewhere near right. But when it comes to setting the voltage regulator, watch out. The only safe thing is to use a portable shop meter.

The regulator should be set at 74 volts for most systems with 32-cell lead-acid batteries. Different settings may be used at times, depending on the temperature and service. In hot climates a 72-volt setting may keep the gravity up without too much water consumption. In cold climates, a 76-volt setting may be needed to get enough charge. The correct setting for any service or climate is the lowest voltage that will keep the gravity up where it belongs without using too much water, Fig. 7.

If you get a locomotive whose battery record shows that the gravity is getting lower day by day, you will want to raise the regulator. But don't raise it more than one volt at a time. Then let it run for a few days. If the gravity starts rising, leave it alone. If your setting is too high, you'll find that the gravity stays up all right, but the cells begin to use a lot of water. That means you are overcharging and gassing the battery, Fig. 7. Try lowering the setting one volt. If the gravity and water consumption level out in a few days, leave the regulator alone.

On locomotives operating in pool service the voltage setting for all regulators is determined by experience. All the maintainer does is check with his portable instruments and report any settings that are off.

Alert maintainers keep six points in mind when checking or changing regulators. They are:

1. Don't change the setting if gravity, water and voltage look okay.
2. When making a setting, be sure to check and adjust the setting only when the regulator is warmed up.
3. Check the setting at both idle and top engine speeds. If there is more than one volt difference, readjust.
4. When making a check or adjustment be sure the load on the charging generator is less than 100 amp.
5. Always have the regulator cover in place when you check or adjust the setting.
6. Lock the voltage adjustments when you finish.

More damage is probably done to lead-acid batteries by overcharging than by anything else. A regulator set too high or in bad order may overcharge the battery for a long time. Then you have severe gassing, loss of active material from the plates and a "hot" battery. You can smell such trouble if you are anywhere near it. The smell is peculiar and gives a sharp burning sensation.

Watch out for explosive gasses when you open the battery box doors on a hot battery. If the cells feel hot, remove some vent caps and see if the solution isn't bubbling like boiling water. The hot solution may have already overflowed through the vents onto the cell tops. You'll want to clean it up at once and get after the cause of the heating. This is likely to be in the regulator. It will pay not to let the locomotive go out again until the cause is found and fixed.

Emergency Charging

If a locomotive comes in with the engine down and the battery dead, you'll need some way to crank it up and start a recharge into the battery. If the locomotive has an external charging receptacle and your shop has a charging line, you're okay. If not, you can connect the leads of a large welding set to the battery terminals. Be sure to check polarity of the generator with a voltmeter. Put the plus lead on the positive terminal of the battery and the minus lead on the negative. Connect a switch between the welder and the battery. Have the welder running and its voltage higher than the battery before you close the switch. Pump all the amperes you can get into the battery for an hour or two. By that time, you will have enough charge in it to crank the engine. But don't leave the welder running like that for much longer, or you will begin to overcharge. Then you will get bad gassing and a really hot battery. Open the switch before you shut the welder down.

Repairs

Heavy repairs will probably be made by the battery manufacturer or the railroad's central repair shop. So the maintainer has very little to do except change out complete trays. Just the same, it's good to know a few stunts about emergency repairs.

Cell jars are sometimes cracked in service. If the solution leaks out and gets below the tops of the plates, the entire tray containing the cracked jars should be replaced at once. You can keep the locomotive in service while waiting for the replacement tray by jumpering the damaged cells. However, don't cut out too many cells. The limit is 4 or 5 on a switcher that always runs by itself, and 2 or 3 on a road locomotive that always runs in multiple with other locomotives. Of course, the rest of the cells have to be in top condition to crank the engine.

To jumper out a cell, shut down the engine and open the battery switch. Remove, or cut off with a hacksaw, the connector that joins the bad order cell with one of its neighbors. Then get a piece of cable (same size as those connecting the trays) with bolt lugs on either end. Connect it securely across the bad cell or cells, Fig. 8. In some cases, you may have to drill the straps to bolt your cable. Start the engine and set the voltage regulator down about 2 volts for every cell you have jumpered out. This will permit charging the remaining cells at their normal charging voltage.

When you get the replacement tray on the locomotive, be sure to set the regulator back to 74 volts. You should check the gravity of the cells in the replacement tray. If it is much lower than the remaining cells, you should charge the replacement cells to bring them up to the same level. If you don't, you will have a weak battery.

Sooner or later, you will run across a worn out battery. This condition develops gradually. The gravity readings keep getting lower. You may also find that the battery won't take much of a charge. If you try setting the regulator up, you only seem to boost water consumption and create more gassing. You'll also notice that the cab lights go quite dim when you crank the engine. About this time you should start looking for a new battery. It's best to replace a worn out battery before it causes a road failure.

Safety

Remember three things when working around batteries. If you make them regular habits you will run very little chance of personal injury.

First, lead-acid batteries give off explosive gasses when being charged. Don't smoke or carry a lighted cigarette, cigar, pipe or torch around the battery box. And don't assume the gas goes away the minute you shut down the engine—it doesn't!! ! ! !

Second, watch out for flash from electrical shorts and grounds. You won't get much of a shock from a battery, but you can get a bad burn, so when you work around a battery throw a heavy rubber mat or felt pad over the cell tops. If you are going to remove some trays, open the battery switch. Then you won't get any arcs when you unbolt the cables.

Third, the acid solution is powerful stuff and can do a lot of damage. If it gets on your pocket tools, dunk them in water right away and wipe them dry. If you get a few drops on your shoes or overalls, soak the spots at once with a rag dipped in a baking soda solution. If you get a lot on, the best thing is to soak the garment or shoes in a pail of water. If you get some on your hands, wash it off at once. If any gets near or into your eyes, get first aid as fast as possible.

Summing Up

Considering the job it does, the battery doesn't ask for much attention. Just a little care at regular intervals will do the trick. If you know the language of the battery, it will quickly tell you when anything is wrong. Paying attention and playing the game according to rules will soon get you a reputation for never having any battery trouble.

Questions and Answers

Interchange Rules

This is the second installment of a new series of questions and answers on the Association of American Railroads Code of Rules Governing the Condition of, and Repairs to, Freight and Passenger Cars for the Interchange of Traffic which may help car men clarify their understanding of the philosophy, intent and requirement of the Interchange Rules. The answers given to the questions are not to be considered interpretations of the rules of Interchange, which can only be rendered by the Arbitration Committee acting officially. The comments, however, will come from a background of intimate association with the application of the rules. Obviously, comments or opinions as of today, may be inapplicable after a revision of the rules or further interpretations by the Arbitration Committee.—Editor.

16-Q.—When a car is on the repair track for adjustment of lading and one cast iron wheel is found to have two adjoining comby spots, each consisting of a continuous cavity of 1½ in. in length, may the pair of wheels involved be removed at expense of the car owner?

A.—Yes.

17-Q.—Why is it proper to apply cotter keys to knuckle pins of hopper cars and fixed-end gondolas?

A.—To prevent the loss of knuckle pins and other coupler parts when such cars are turned over on car-unloading machines.

18-Q.—Is it proper to apply an A.A.R. Standard helical truck spring when a long-travel truck spring standard to the car is removed on account of being defective?

A.—No. Such a mixed combination would not function properly. Furthermore, this substitution would require the issuance of defect card for labor and material.

19-Q.—How are allowances in the so-called Price Rules established?

A.—By the semi-annual solicitation of prices for car repair material from nine representative railroads in various geographical locations of the United States and from one road in Canada, on the basis of material delivered to selected central points on such roads, freight included. Seven per cent for store expense and one per cent for interest on stock investment is then added to the quotations for each of the price items listed. The averages are then computed and these represent the prices which are published on January and August 1 each year.

20-Q.—In case a coupler or brake beam drops from preceding car and derails the car following, who is responsible for such coupler or brake beam?

A.—Handling line is responsible.

21-Q.—In case a coupler drops from first car, ripping brake rigging off second and third cars and derailing the fourth car, who is responsible for damage to the first, second and third cars?

A.—Handling line is responsible.

22-Q.—What is the intent of the first Paragraph of Passenger Car Rule 19 as it relates to Note 4 under Paragraph (g) of Rule 98 in the Freight Code, accuracy of dimensions for service metal on wrought steel wheels being involved?

A.—It is generally understood that the principles established in the Freight Code are also applicable insofar as similar conditions involving passenger cars are concerned, unless the Passenger Code contains specific provisions to the contrary.

23-Q.—What credit should be allowed for one-wear wrought-steel wheels removed from a foreign car by an intermediate road on authority of defect card covering slid flat wheels, such wheels being subsequently reclaimed by turning and applied by repairing road to another car?

Regardless of whether such wheels are subsequently scrapped or reclaimed by turning, the repairing line may credit them as scrap when removed.

24-Q.—Where a tank head is removed, repaired and replaced on authority of defect card, may charge be rendered on basis of Item 188-C of Interchange Rule 101?

A.—No. Charge on the basis of Item 193 of Rule 107 is proper.

25-Q.—Is it intended that cars on repair track for any purpose which have Former A.A.R. Standard "T" type coupler draft key retainers in serviceable condition shall have an approved lock applied at car owner's expense, even though none of the draft rigging parts requires repairs?

A.—Yes.

26-Q.—Where multiple-wear wrought-steel wheels with full flange contour have only 1/16 in. service metal remaining, may they be applied to a foreign car and charge therefor rendered versus car owners?

A.—Yes. However, it is the usual practice to avoid such installations where wheels with a greater amount of service metal are available.

27-Q.—In computing the depreciated value of badly damaged or destroyed cars for billing purposes where car involved is subsequently repaired, should the per pound prices in effect when repairs are made be used?

A.—No. The per pound prices in effect as of the date of damage to car should be used.

28-Q.—How should allowances for serviceable material recovered from destroyed car and returned to car owner be computed, where settlement for car involved is made on a reproduction cost basis?

A.—Allowances should be computed as follows: (a) Determine per pound price for car involved by dividing the sum of reproduction cost by the light weight of car; (b) The car owner should use this same per pound price in payment to handling line for such serviceable parts, depreciated on the same basis as used in settlement of the entire car; (c) In the case of AB brake equipment, auto loading devices, circulating air fans, or any of the parts returned which

are made of high tensile steel, the special allowance (depreciated on same basis) should also be included; (d) To the above should be added the scrap value of such parts at one-half cent per pound and (e) The same principle outlined in Section J of Rule 112 as to handling and shipping of such material should be followed.

29-Q.—What charge should be made for C.O.T.&S. of air brakes on car having one set of "AB" valves and two brake cylinders?

A.—The price listed in Item 15 of Rule 111 plus the allowance specified in Item 21 of the same rule should be used.

30-Q.—Where pipe coupling having right and left hand threads is applied, should labor charge be made on the basis of one or two connections?

A.—Charge on the basis of two connections is proper, per Item 3 of Rule 111.

31-Q.—Does the splicing of lining or ceiling boards in house cars constitute wrong repairs?

A.—Where properly performed, charge for the splicing of such boards may be made versus car owner, per Items 95 and 98 of Rule 107.

Schedule 24 RL Air Brakes

PRINCIPLES OF OPERATION (*Continued*)

1613-Q.—What should be the indication when so balanced?

A.—The reading of the dial of the variable rheostat should agree with the known number of vehicles in the train.

1614-Q.—With what may the detector relay *Y* be compared with?

A.—This relay serves in place of the galvanometer generally used in the Wheatstone Bridge.

1615-Q.—How is the relay affected at the time the bridge is balanced?

A.—The relay is de-energized and its contacts are in the de-energized position.

1616-Q.—What is the resulting current flow?

A.—In this position the white lamp is supplied with current.

1617-Q.—Suppose that the number of magnet valves does not agree with the dial setting of the rheostat?

A.—The bridge is unbalanced and the relay becomes energized.

1618-Q.—What is the indication when the relay becomes energized due to an unbalanced condition?

A.—Current is supplied to the red lamp.

1619-Q.—Are their modifications required in the basic Wheatstone bridge in order to make it suitable for use in the circuit checking equipment?

A.Yes, certain modifications are required.

1620-Q.—Describe one change necessary.

A.—The first change consists of means for compensating for changes in temperature of the *21-B* Magnet Valves.

1621-Q.—How is this accomplished?

A.—By means of a temperature compensating coil which comprises a part of the lower left arm of the bridge.

1622-Q.—Describe this coil.

A.—This coil is wound with copper wire and is mounted outside of the locomotive where it is subjected to approximately the same temperature as the *21-B*-Magnet Valves.

1623-Q.—How does this installation eliminate possibility of the Wheatstone bridge becoming unbalanced because of temperature changes?

A.—Any changes in resistance of the *21-B*-Magnet Valves due to changes in temperature have a corresponding effect on the temperature compensating coil.

1624-Q.—What other modification is required?

A.—There must be some means for insuring that the Wheatstone bridge is operating as intended.

1625-Q.—Give examples for the above.

A.—In Fig. 1 there is no means for insuring that battery supply is connected to the Wheatstone bridge and that the detector relay circuit is intact.

1626-Q.—What means are provided for insuring that these two points are checked?

A.—Fig. 2 shows this arrangement. The detector relay *Y* has a back contact which supplies current to either of two relays *W* or *X*.

1627-Q.—Upon what does the relay selection depend?

A.—The position of a directional relay *V*.

1628-Q.—What happens if either of the two relays are energized?

A.—One or the other of two arms of the Wheatstone bridge is short-circuited.

1629-Q.—What is the result of this short-circuit?

A.—Sufficient unbalance is produced in the bridge to cause detector relay *Y* to become energized.

1630-Q.—What happens when relay Y becomes energized?

A.—This opens the battery supply to the *W* or *X* relay and at the same time closes a front contact to supply energy to directional relay *V* to reverse the position of its contact.

1631-Q.—What transpires after a given time delay?

A.—At the expiration of a given time delay the *W* or *X* relay will become de-energized, thus removing the short-circuit from one of the arms of the Wheatstone bridge and restore it to proper balance, thus allowing relay *Y* to become de-energized.

* This series of questions and answers relate specifically to the Alco-G.E. Diesel electric locomotives. The figure numbers and references, by number, to diagrams, etc., relate to the current edition of the Alco-G.E. operating and maintenance manual.

1632-Q.—Is this cycle repeated?

A.—Yes, the remaining one of the two "Y" and "X" relays becoming de-energized during this portion of the cycle.

1633-Q.—What means are used to convert proper operation of the Wheatstone bridge into the desired visual indication?

A.—Plate 3 illustrates this arrangement. As previously stated, *W* and *X* relays are alternately energized. By means of a front contact on these relays together with an additional contact on *V* relay, pulses of current are supplied to relay "U" when *W* or *X* are energized.

1634-Q.—What may cause these relays to fail to operate in the proper sequence?

A.—it may be because of bridge unbalance due to a fault in either the application or release circuits, or because of a fault in the Wheatstone bridge itself.

1635-Q.—What is the inevitable result of any fault which may exist?

A.—Irrespective of the cause, the sequential action of relays *W* and *X* will be stopped.

1636-Q.—What would be the result?

A.—Pulses of current will then cease being supplied to relay *U* which will then become de-energized.

Diesel-Electric Locomotives*

866-Q.—What is the initial preparation for removal of extension shaft and vibration damper from crankshaft?

A.—Support extension shaft with a hoist and rope looped around the shaft at the flange end. Remove capscrews securing extension shaft to crankshaft flange.

867-Q.—What operation should follow?

A.—Slide extension shaft forward until dowel, positioning shaft to vibration damper, is clear. Make sure vibration damper does not fall from crankshaft. Lift extension shaft free from crankshaft.

868-Q.—What is the procedure for removing crankshaft split gear?

A.—Remove cotter pins and clamping ring bolt nuts from split gear. Remove bolts and clamping rings.

869-Q.—What operation should follow?

A.—Remove one-half of split gear, the other half, which is doweled to crankshaft, can be freed by tapping with a wooden mallet.

870-Q.—What cleaning attention should be given the crankshaft?

A.—Clean the main journals and crank pins with paint thinner and rags. Lubricating oil passages must be cleaned and wearing surfaces and fillets inspected for fractures.

871-Q.—What is the procedure for inspection?

A.—Magnuflux the crankshaft if the necessary equipment is available. All bearing surfaces should be inspected with finger nails for burrs which can be removed by stoning and the use of crocus cloth.

872-Q.—What should be done in regards to crankshaft journal measurements?

A.—They should comply with tolerances listed in Table of Clearances.

873-Q.—What inspection should be made of the main bearing shells?

A.—They should be carefully examined for shelling, pitting and wear whenever removed from the engine.

874-Q.—Should pitted bearings be used again?

A.—Bearings with a very slight pit may be used again, but if wear has progressed to any extent the shells should be renewed.

875-Q.—How should the shells be checked for wear?

A.—Micrometer measurements for shell thickness should be taken at each third portion of the shell to check for bearing wear. The Table of Clearances should be followed.

876-Q.—Is the bore of standard bearings plated in any way?

A.—Yes. The bore of all standard bearings is plated with a .0008-.0017 in. lead-tin overlay.

877-Q.—What should be done in case a bearing shell shows signs of wear through the overlay?

A.—It should be replaced with a new shell.

878-Q.—What is finally applied to the bearing surface?

A.—A final flash plating of .0001 in. thickness is applied to the entire bearing surface on all bearings.

879-Q.—What is the purpose of this plating?

A.—For the sole purpose of preventing corrosion while in transit or storage.

880-Q.—Where does the flash plating also appear?

A.—On the thrust faces of the thrust bearing.

881-Q.—If a show of red metal is apparent, should this bearing be rejected?

A.—Not unless the red metal and the shaft show signs of distress.

882-Q.—What should be done if old bearings are to be re-applied to the crankshaft?

A.—Check the spread of each half shell by fitting it to the contour of the main journal bore. This should be a snug fit with no clearance between the shell and bore.

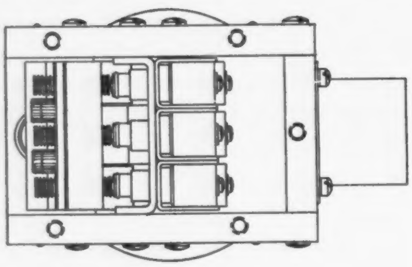
883-Q.—What should necessitate rejection of a bearing?

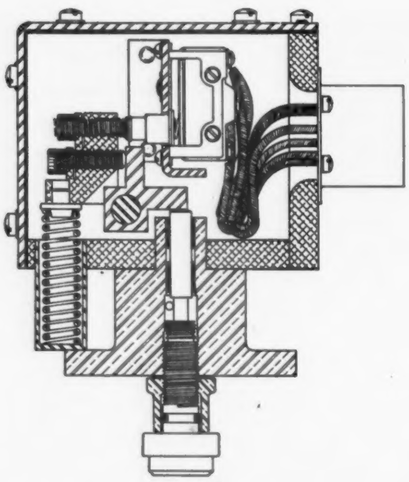
A.—If there is any indication that the back of the bearing does not conform exactly with the journal bore, the bearing should not be used.

884-Q.—What should be done if a new bearing shell is to be installed?

A.—Stamp on the new shell with the same figures and in the same location as on the old shell.

NEW DEVICES

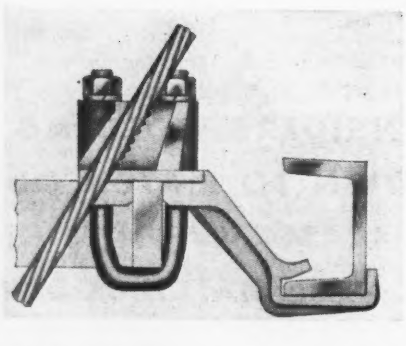




Locomotive Engine Temperature Control

A simplified means of controlling diesel engine temperatures, called the Kysor Multistat is being introduced by the Kysor Heater Company, Cadillac, Mich. Made to control the operation of shutters, fans, etc., the Mupltistat is available with three stages as shown, or with four, five or six stages. One thermostatic element only is used to control all switch stages. This assures that all operations will occur in proper sequence.

Temperature setting on switches may be adjusted from ½ deg. F. to 10 deg. F. between each switch. The switch operating sequence may be selected and locked. Switches are precision, double-throw, with nickel-silver alloy contacts in heat resistant cases. All moving parts are hard chromium plated and the entire unit is protected by chromium plating, anodizing and the use of non-corrosive materials. The cover is gasketed, and sealed and all wiring is carried through a heavy-duty, multiple-conductor plug connector. The overall size of the six-stage unit is 6 in. x 6 in. x 6 in.



Brake Beam Safety Support

AAR approval has been granted to a new brake beam safety support manufactured by the Grip Nut Co., 310 South Michigan avenue, Chicago 4. The new safety support, designed to prevent derailment as a result of brake beam or brake hanger failure, is adjustable to provide proper clearance over the bolster and can be applied to loaded or empty cars without having to jack the car or remove the trucks.

No drilling, riveting or welding is needed for installation. The support is attached to the brake beam only. Detaching one side of the support permits removal of the brake beam, and wheels can be removed without disturbing the supports.

Work Clothes Made Fire Retardant

A chemical process has been perfected to render work clothing impervious to direct flames for the life of the fabric. Known as Permaproof 300, it has been approved by the York Research Corporation for industrial use in high heat areas such as steel mills, foundries, locomotive repair shops, etc.

The process was developed by Treesdale laboratories and Textile Processing Company, Pittsburgh, Pa. Repeated launderings or dry-cleanings will not destroy the fire-retardent properties of treated fabrics, according to the manufacturer.

■

Temperature Control System

Employing electric and pneumatic thermostats, this railroad temperature control system was designed to regulate summer ventilation and winter heating in commuter coaches being built for the Long Island Railroad.

Made by the Minneapolis-Honeywell Regulator Company, Minneapolis, the system is said to be sensitive enough to detect changes in the number of passengers in the car and to compensate for any changes. In summer, the thermostats regulate the speed of four fans recessed into the coach roof, increasing their velocity to bring in more fresh air as the number of passengers in the coach increases.

By metering the heat via electric heaters during the winter in proportion to the need, the system is also expected to result in power conservation.

■

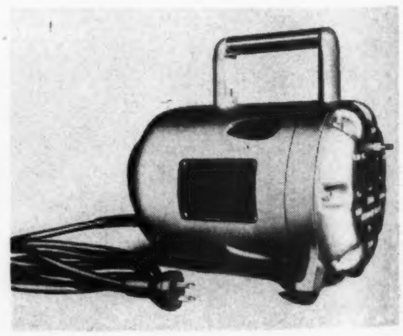
Leakproof Joint Compound

This sealant compound for flanged and threaded pipe connections does not contain lead, graphite, oil or inflammable solvents. It is applied as a liquid and when exposed to air, forms a resilient solid that is said to withstand severe pressure, vibration and chemical action.

Formulated by the West Chester Chemical Company, West Chester, Pa., and named Cyl-Seal, it is chemically inert and resists action of oil, gas, refrigerants, acids, alkalis, and most chemicals and solvents.

The product does not harden completely and never freezes connections but does develop sufficient rigidity to insure a leakproof joint at pressures exceeding 10,000 lb. per sq. in. It has been successfully applied to piping in railroad equipment.

■



Tachometer Tester

A tachometer tester, Sweeney Model 1100, features 7 output speed shafts of 300, 500, 600, 720, 800, 1,000 and 1,800 r.p.m., for testing most types of portable tachometers. A built-in reversing switch permits clockwise or counter-clockwise rotation of the shafts for testing tachometers in either direction. For a comparative reading, the drive shaft of the tachometer is inserted into the desired speed shaft on the tester. Driven by a synchronous motor, the tester has the same accuracy as an electric clock. It operates on 115 volts, 60 cycles.

The unit which weighs 23 lb. is an improved version of an earlier model. It is made by B. K. Sweeney Manufacturing Co., 1601 23rd street, Denver 17, Colo.

■

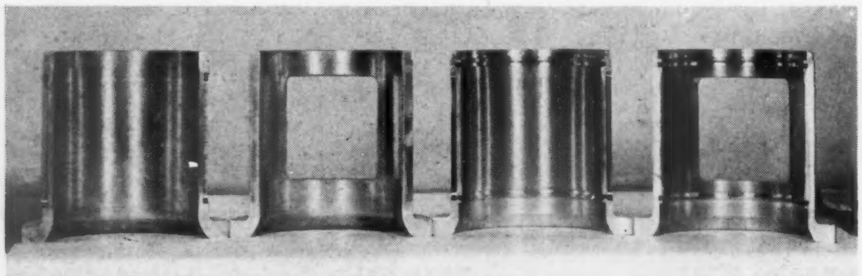
Diesel Engine Oil Seal and Coating

Three new compounds to increase diesel engine availability and cut unnecessary down-time for shop work have been made available by the Spring Packing Corporation, Chicago 4. They are SP-1000 diesel engine oil seal, SP-1005 Electriseal and SP-1005-OR.

SP-1000 can be applied in the shop as a preventive measure or applied during engine turn-around when inspection reveals oil leakage. It can be added to any hot or cold engine at the exposed edge of a cleaned joint and allowed to cure.

SP-1005 is a flexible plastic coating that can be used to seal out oxidation and corrosion at current transfer points and connections. The formulation can be molded onto the electrical connection by forming with the hand. It will not crack, oxidize or fall off, even when subject to vibration and weather conditions.

SP-1005-OR was developed for application as an insulation on electrical connections where oil leakage or dripping is a possibility.

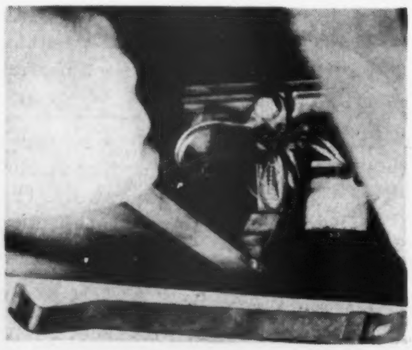


Traction Motor Suspension Bearing

The General Electric Company, Schnectady, N. Y., has developed a traction motor suspension bearing which the maker claims will enable more than 90 per cent of the locomotives equipped with the bearing to operate between monthly inspections without addition of oil to the axle caps. The bearing is designed on the principle that the correct approach to better oil mileage is not to supply a minimum of oil to the journal, but rather to supply as much as possible and return the excess to the cap. Oil return grooves in the lining, are the crux of the new bearing.

Extensive field testing was carried on for 18 months to find the best "oil return" type bearing. Oil level versus mileage was measured on a total of 26 locomotives on 11 different railroads with the result that the new bearing consistently showed that in any type of service locomotives so equipped can run three times longer between oilings than with older type bearings. The design is such that railroads can obtain the same benefits by modifying old bearing linings.

Device for Changing Carbon Brushes



A spring-lifting device making it possible for diesel-electric locomotive maintenance men to change carbon brushes "from the pit" with relatively little effort and greater safety is a new General Electric product.

Made from hardened tool steel to withstand wear, the lifter is a lever resembling a crowbar. A socket engages the tip of the lever to be lifted and keeps it from snapping down on the maintainer's fingers, should pressure on the handle be relaxed. Once the spring is lifted, the tool is securely engaged and the guideways prevent the spring from slipping.

The lifters pry-push action makes it possible to lift springs where no brushes are contained in the holders. A long handle permits free end of tool to be swung around, giving free access to brushholders.

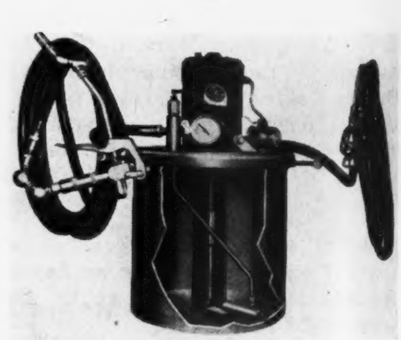
■

Magnetic Base Indicator Holders

Magnetic base indicator holders to eliminate cumbersome haphazard clamping and to speed the job and give greater accuracy have been introduced by the Lufkin Rule Company, Saginaw, Mich. The indicator holder is placed against any round of flat iron or steel surface, and a powerful permanent magnet attaches instantly. With attachments, nearly all dial indicators can be held on lathes, shapers, mills, planes. The swivel action post can be quickly and firmly secured in position with knurled locknut, and a sensitive friction joint gives accurate adjustments.

Three models are available — the No. 100 with a 50-lb. magnetic pull; No. 101, the same as No. 100, but with an extra fine adjustment feature; and the No. 150; a heavy duty unit with a permanent magnet providing a 100-lb. pull.

■



Battery-Powered Greasing Unit

This unit was designed to pump grease directly from the drum and should be useful to operators of commercial vehicles, mobile tools or rolling stock. Named Greasemaster Senior, it is available from G & T Industries, Wichita 2, Kan.

Like earlier models, it operates on a

(*Continued on page 124*)

NEWS

Radio-Active Atoms in Diesel Service Tests

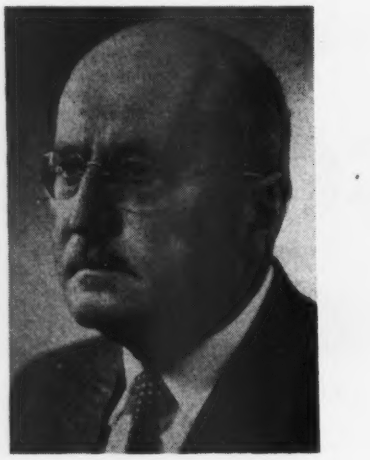
RADIO-ACTIVE ATOMS are now being used in Denver & Rio Grande diesel locomotive service tests in an effort to obtain information about dust, oil and engine wear which can be secured in no other way. The tests have been in progress for several weeks using a diesel wrist pin activated for a short period of time and under suitable protection with gamma rays. It is expected that some conclusions will be drawn from these preliminary tests within the next 60 to 90 days.

Gilbert Heads B.L.F.&E.

H. E. GILBERT, a vice president of the brotherhood since 1947, succeeds the late David B. Robertson as president of the Brotherhood of Locomotive Firemen & Enginemen.

Dr. Adolph Meyer To Receive Henderson Medal

DR. ADOLPH MEYER will be awarded the George R. Henderson Medal by the Franklin Institute, Philadelphia, for his accomplishments in the gas-turbine field. The medal will be presented at the annual Medal Day Ceremonies in Franklin Hall on October 21. The citation which will accompany the award reads: "In consideration of his basic contributions to scientific research on the gas-turbine power plant, and, in particular, to his pioneer work in the development of the first successful gas-turbine locomotive."



Dr. Adolph Meyer

At Brown Boveri & Co., Baden, Switzerland, where he was managing director and chief engineer until his retirement in 1946, Dr. Meyer developed the first continuous combustion gas-turbine locomotive for the Swiss Federal Railways. The locomotive, which was placed in service in the fall of 1941 and is still in continuous operation, has a rated output of 2,200 hp. at the turbine shaft connected to the main generator drive. It has a 2-8-2 wheel arrangement with four traction motors and weighs 101 tons, 70 tons of which are on the drivers.

Shop Improvements

Baltimore & Ohio.—The locomotive back shop at Dubois, Pa., discontinued for locomotive repairs last spring, will be converted into a modern freight-car shop capable of making heavy repairs to 20 cars a day. The improved facility will be ready for operation next November and it is hoped the entire reconversion job will be completed in June 1954.

Northern Pacific.—Locomotive repair facilities at Mississippi street shops St. Paul, are being expanded at a cost of $220,000. Work on the project, includes conversion of a former steam locomotive tank shop into a second shop for servicing diesel locomotives. This 70-ft. by 100-ft. building adjoins the existing diesel maintenance shop completed in 1946. Walls of the tank shop will be raised and a new roof built to permit installation of a 30-ton traveling crane which will span the entire width of the building. A drop table pit, serving the present diesel shop, will be extended into

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

Item No.		Month of May 1953	Month of May 1952	5 months ended with May 1953	5 months ended with May 1952
	FREIGHT SERVICE (DATA FROM I.C.C. M-211 AND M-240)				
3	Road locomotive miles (000) (M-211):				
3-05	Total, steam	12,357	16,908	62,451	92,441
3-06	Total, Diesel-electric	32,183	27,729	152,399	132,424
3-07	Total, electric	759	786	3,716	3,957
3-04	Total, locomotive-miles	45,366	45,453	218,870	228,888
4	Car-miles (000,000) (M-211):				
4-03	Loaded, total	1,738	1,663	8,261	8,261
4-06	Empty, total	953	940	4,477	4,500
6	Gross ton-miles-cars, contents and cabooses (000,000) (M-211):				
6-01	Total in coal-burning steam locomotive trains	23,167	30,886	111,347	166,539
6-02	Total in oil-burning steam locomotive trains	5,867	7,627	28,731	40,933
6-03	Total in Diesel-electric locomotive trains	91,781	78,150	426,413	367,810
6-04	Total in electric locomotive trains	2,226	2,245	10,523	11,042
6-06	Total in all trains	123,277	119,035	578,078	586,626
10	Averages per train-mile (excluding light trains) (M-211):				
10-01	Locomotive-miles (principal and helper)	1.03	1.03	1.03	1.04
10-02	Loaded freight car-miles	41.50	40.00	40.90	39.60
10-03	Empty freight car-miles	22.80	22.60	22.20	21.60
10-04	Total freight car-miles (excluding caboose)	64.30	62.60	63.10	61.20
10-05	Gross ton-miles (excluding locomotive and tender)	2,948	2,863	2,864	2,814
10-06	Net ton-miles	1,346	1,312	1,296	1,302
12	Net ton-miles per loaded car-mile (M-211)	32.40	32.80	31.70	32.90
13	Car-mile ratios (M-211):				
13-03	Per cent loaded of total freight car-miles	64.60	63.90	64.90	64.70
14	Averages per train hour (M-211):				
14-01	Train miles	18.30	17.80	18.30	17.60
14-02	Gross ton-miles (excluding locomotive and tender)	53,436	50,449	51,930	48,805
14	Car-miles per freight car day (M-240):				
14-01	Serviceable	46.80	45.20	45.40	45.20
14-02	All	44.60	43.00	43.20	43.00
15	Average net ton-miles per freight car-day (M-240)	934	901	888	915
17	Per cent of home cars of total freight cars on the line (M-240)	46.80	45.60	47.10	42.70
	PASSENGER SERVICE (DATA FROM I. C. C. M-213)				
3	Road motive-power miles (000):				
3-05	Steam	4,299	6,826	23,252	37,643
3-06	Diesel-electric	20,240	18,731	99,097	90,455
3-07	Electric	1,520	1,624	7,797	8,222
3-04	Total	26,059	27,181	130,146	136,327
4	Passenger-train car-miles (000):				
4-08	Total in all locomotive-propelled trains	260,244	270,029	1,306,742	1,350,746
4-09	Total in coal-burning steam locomotive trains	25,460	34,312	134,404	198,295
4-10	Total in oil-burning steam locomotive trains	15,909	26,499	72,784	128,889
4-11	Total in Diesel-electric locomotive trains	204,029	191,290	1,012,113	932,008
12	Total car-miles per train-miles	9.68	9.70	9.74	9.72
	YARD SERVICE (DATA FROM I.C.C. M-215)				
1	Freight yard switching locomotive-hours (000):				
1-01	Steam, coal-burning	608	826	3,015	4,546
1-02	Steam, oil-burning	106	163	561	846
1-03	Diesel-electric[1]	3,499	3,193	16,931	15,820
1-06	Total	4,232	4,205	20,613	21,330
2	Passenger yard switching hours (000):				
2-01	Steam, coal-burning	21	26	108	158
2-02	Steam, oil-burning	7	11	33	58
2-03	Diesel-electric[1]	258	258	1,284	1,280
2-06	Total	318	328	1,585	1,664
3	Hours per yard locomotive-day:				
3-01	Steam	6.70	6.80	6.50	7.20
3-02	Diesel-electric	16.20	16.20	16.30	16.70
3-05	Serviceable	14.80	14.20	14.70	14.50
3-06	All locomotives (serviceable, unserviceable and stored)	13.10	12.30	12.90	12.60
4	Yard and train-switching locomotive-miles per 100 loaded freight car-miles	1.68	1.74	1.72	1.78
5	Yard and train-switching locomotive-miles per 100 passenger train car-miles (with locomotives)	0.76	0.75	0.75	0.76

[1]Excludes B and training A units.

the new addition and additional removable tops for the table will be installed. The new building will be used primarily to facilitate handling of trucks, engines, traction motors and generators.

Locomotive Depreciation Rates on the Southern

An annual depreciation rate of 48.75 per cent has been prescribed by the I.C.C. for steam locomotives carried on the books of the Southern, which recently achieved complete dieselization of its operations. The commission's order, dated August 18, modified a previous order to prescribe a new scale of depreciation rates for all Southern equipment.

The prescribed rates, in addition to that on steam locomotives, are as follows: Diesel switchers, 3.89 per cent; diesel road locomotives, 4.9 per cent; diesel-motored passenger cars, 4.49 per cent; freight-train cars, 3.6 per cent; lightweight passenger-train cars, 3.28 per cent; heavyweight sleeping cars, 4.43 per cent; all other passenger-train cars, 4.29 per cent; work equipment, 4.94 per cent; miscellaneous equipment, 11.2 per cent.

Miscellaneous Publications

Vacuum Impregnation: F. J. Stokes Machine Company, Tabor Road, Philadelphia 20. Twenty-four-page, three-color catalog, No. 760, "Vacuum Impregnation" illustrates and describes this process, presenting applications and values, uses and specifications of standard Stokes impregnators and storage tanks. Actual installations and examples of other Stokes high vacuum processing equipment, pumps and gages also illustrated.

■

Pipe Tools: Beaver Pipe Tools, Inc., 300-500 Dana avenue, Warren, Ohio. Revised catalog and resale price sheet gives complete information on Beaver pipe and bolt threaders, square end sawing vices, pipe reamers, power and hand cutters, pipe and bolt machines, new Beaver Model "D" power drive, No. 55 nipple chuck, and Nos. 2 and 4 direct pressure pipe cutters.

■

All-Service Diesel-Electric Locomotive: Baldwin-Lima-Hamilton Corporation, Philadelphia 42. Eight-page, two-color bulletin, No. 2002, gives mechanical details and specifications of Baldwin-Westinghouse, 1600-hp., AS-616, all-service, diesel-electric locomotive; also includes tractive-effort curve and tonnage rating table showing trailing-ton loads that can be hauled over various grades at different operating speeds.

■

Air Filters: Air-Maze Corporation, 25000 Miles Road, Cleveland 28. Eight-page two-color folder, RRC-653, illustrates and describes for diesel locomotives, oil bath type engine air filters, carbody panel filters, engine air intake panel filters, and panel adaptors and silencers; and, for coaches, diners and sleeping cars, fresh and recirculated-air filter panels, Greastop filters for galley range canopies, and flame arresting panels.

SUMMARY OF MONTHLY HOT BOX REPORTS

	Foreign and system freight car mileage (total)	Cars set off between division terminals account hot boxes: System	Foreign	total	Miles per hot box car set off between division terminals
July, 1950???	2,745,932,894	....	....	23,957	114,619
August, 1950	2,937,455,020	7,422	15,490	22,912	128,206
September, 1950	2,974,297,739	6,541	12,881	19,422	153,141
October, 1950	3,165,997,915	4,343	8,935	13,278	238,439
November, 1950	2,868,871,913	2,536	5,331	7,867	364,672
December, 1950	2,813,042,212	2,278	5,968	8,246	341,140
January, 1951	2,840,847,511	2,870	8,436	11,306	251,269
February, 1951	2,425,226,454	4,528	14,063	18,591	130,452
March, 1951	3,063,173,942	3,667	10,078	13,745	222,857
April, 1951	2,996,562,763	3,702	8,914	12,616	237,521
May, 1951	3,013,634,782	5,631	13,737	19,368	155,599
June, 1951	2,874,873,495	7,074	15,376	22,450	128,057
July, 1951	2,768,920,095	8,886	18,823	27,709	99,929
August, 1951	3,809,371,111	9,023	19,092	28,115	107,038
September, 1951	2,925,570,545	6,472	13,565	20,037	146,008
October, 1951	3,116,490,095	4,131	9,053	13,184	236,384
November, 1951	2,939,503,144	2,022	4,405	6,427	457,368
December, 1951	2,752,316,133	2,130	5,398	7,528	365,611
January, 1952	2,824,298,630	3,208	7,197	10,405	271,437
February, 1952	2,809,162,671	2,723	6,473	9,196	305,477
March, 1952	2,943,812,727	2,594	5,877	8,471	347,517
April, 1952	2,766,313,714	3,826	7,759	11,585	238,784
May, 1952	2,918,508,445	6,020	10,938	16,958	172,102
June, 1952	2,672,512,889	8,466	14,495	22,961	116,394
July, 1952	2,575,298,912	10,566	15,833	26,399	97,553
August, 1952	2,924,917,122	11,658	17,535	29,193	100,192
September, 1952	2,931,129,734	7,536	13,608	21,144	138,627
October, 1952	3,093,990,289	4,058	8,053	12,111	255,469
November, 1952	2,984,101,808	2,198	4,501	6,699	445,455
December, 1952	2,869,928,617	1,742	3,632	5,374	534,040
January, 1953	2,828,906,282	2,219	4,123	6,342	446,059
February, 1953	2,625,563,462	2,111	4,059	6,170	425,537
March, 1953	2,904,227,804	2,696	6,077	8,769	331,192
April, 1953	2,850,752,648	3,383	6,435	9,818	290,359
May, 1953	3,013,610,843	5,892	11,433	17,325	173,945
June, 1953	2,926,001,360	8,537	15,296	23,833	122,771

SUPPLY TRADE NOTES

Vapor Heating Corporation.—*J. E. Morris*, district manager at St. Paul, has been transferred to St. Louis as district manager. *W. W. Orr*, Chicago, has been transferred to St. Paul as district manager. *T. J. Mahoney*, St. Louis, has been transferred to Chicago. *T. L. Lehane*, engineering department, has been transferred to the sales department and will work with all Vapor offices on various train-heating problems. *W. J. Burrows* at the Montreal office of Vapor Car Heating Company of Canada, Ltd., has been transferred to Winnipeg, Man., as western manager, and *E. D. O'Neill* at Winnipeg has been transferred to Montreal.

■

Reed Roller Bit Company, Cleco Air Tool Division.—*Ray Kensel*, sales representative in Fort Worth, Tex., has been appointed district sales manager for the Detroit, Cleveland, Cincinnati, and Indianapolis area, replacing *B. O. Stoothoof* who has resigned.

■

American Locomotive Company.—*J. Jos. Smith*, manager of of the locomotive division plant at Schenectady, N. Y., since 1945, has been named manager of plant facilities for the company. *Wallace H. Allison*, general superintendent of the locomotive division plant since February, has been appointed manager. *W. L. Larson*, manager of the ordnance division plant at Schenectady since April, 1952, has been named general plant manager of the Dunkirk and Beaumont, Tex., plants.

■

Acme Steel Company.—*John H. Harper*, assistant chief engineer of the Acme Steel Company at Chicago, has been promoted to chief staff engineer at Riverdale, Ill.

Landis Tool Company.—*A. J. Jones*, in charge of sales engineering, has been appointed chief engineer.

■

Waukesha Motor Company. *Newton H. Willis*, chief engineer of the railroad division, has been appointed manager of the division, succeeding *Lee W. Melcher*, retired.

■

Graybar Electric Company.—The *Graybar Electric Company* has opened another branch in San Bernardino, Cal., with *J. H. Gregerson* as manager and *R. P. Sager* as operating manager. *J. M. Ferguson* has been appointed manager and *R. J. Nelson* operating manager of the Davenport, Iowa, branch. The following have been appointed operating managers: *E. L. Harrelson* at Shreveport, La.; *H. L. Warman* at El Paso, Texas; *H. J. Couch* at Oklahome City, Okla.; *J. P. Flowers* at Allentown, Pa.; *N. F. Clark* at Buffalo, N.Y.; *A. C. Goodwin* at Syracuse; and *E. J. Grady, Jr.* at West Hartford, Conn.

■

Westinghouse Electric Corporation.—*J. C. Frink*, manager of the transportation, marine and aviation department, eastern district, will head that activity for the recently consolidated northeastern region, which embraces territory formerly included in the eastern and New England districts.

■

Electric Storage Battery Company.—*L. M. Gay* has been appointed manager of the Cleveland branch, succeeding W. P. Roche, who has been granted a leave of absence because of his health. Mr. Gay was formerly manager of Exide's Cincinnati branch.

■

Fibercast Corporation.—The *Youngstown Sheet & Tube Co.* has acquired an interest in *Perrault Fibercast Corporation*,

DOW

SAFE DELIVERY ON SOUND PENTA-TREATED LUMBER

DOW wood preservative checks rot and decay, adds years of dependable service to car lumber

The Dow Chemical Company
Dept. PE 3-305, Midland, Michigan

Please send me:

- ☐ List of PENTA treating plants.
- ☐ I am interested in the application of PENTA to________

Name________

Title________

Company________

Address________

City________ State________

PENTA*-treated flat-car beds are good insurance against cargo damage caused by rotted and decayed lumber.

Blocking and other fastenings attached to untreated beds often fail unexpectedly, causing cargo to shift and become damaged. You can guard against failure of this kind and save money doing it by treating flat-car beds, siding, framing and all car lumber with *clean* PENTA.

PENTA protection means fewer trips to the repair shop for lumber replacement and greater ton mileage for every dollar invested in wood car construction.

Over 60 suppliers across the nation can furnish you with PENTA-treated lumber. Be sure to ask your regular supplier about *clean* *PENTAchlorophenol or write direct to THE DOW CHEMICAL COMPANY, Midland, Michigan.

you can depend on DOW CHEMICALS

DOW

of Tulsa, Okla., which will be known as the *Fibercast Corporation.* Its glass fiber-reinforced thermo-setting plastic pipe will be distributed through *Continental Supply Company, Youngstown Steel Products Company* and *Youngstown Steel Products Company of California.*

■

AMERICAN PAMCOR, INC., AIRCRAFT-MARINE PRODUCTS, INC.—*Joseph I. Simpson* has been appointed director of all railroad activity in the new aircraft-Marine Products, Inc., subsidiary organization, American Pamcor, Inc., Havertown, Pa. Mr. Simpson will contact and service railroad accounts.

J. I. Simpson

■

COPPERWELD STEEL COMPANY.—*Stanley E. Noble,* who retired as assistant chief engineer of the Chicago & North Western July 1, has been retained as railroad consultant by the wire and cable division of Copperweld, at Chicago.

■

DOMINION BRAKE SHOE COMPANY.—*Thomas E. Akers,* president, has been elected chairman; *Kenneth T. Fawcett,* vice-president, has been elected president, and *Maynard B. Terry* has been elected vice-president of this Canadian subsidiary of the American Brake Shoe Company.

■

DANA CORPORATION.—*R. R. Burkhalter* has been promoted to the newly created position of assistant executive engineer at Dana, Toledo, Ohio. Mr. Burkhalter joined the Spicer (now Dana) engineering staff in 1929.

■

BUFFALO BRAKE BEAM COMPANY.—*Ernest F. Gladwell,* for many years western and Canadian sales representative, has been appointed assistant to vice-president—sales, at Buffalo, N. Y.

■

WYANDOTTE CHEMICAL CORPORATION.—*Marvin O. Crawford,* special representative, Pacific coast railroads, has been transferred to Baltimore, to service some eastern lines.

■

A. O. SMITH CORPORATION.—The welding products division of *A. O. Smith Corporation* has transferred manufacture of its line of welders from Milwaukee to expanded quarters at Elkhorn, Wis. New construction is under way to add another 16,000 sq. ft. to the Elkhorn plant.

(*Continued on page* 107)

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE SEPTEMBER ISSUE

DIESEL-ELECTRIC LOCOMOTIVE ORDERS

Road	*No. of Units*	*Horse-Power*	*Service*	*Builder*
Canadian National	18	1,600	Road switch	Montreal Loco. Wks.
	24	1,500	Road switch	Gen. Motors Diesel, Ltd.
	8	1,200	Road switch	Canadian Loco. Co.
Indiana Harbor Belt	7[1]	1,200	Switch	Electro-Motive
Pennsylvania	43[2]	1,500	Road switch	Electro-Motive
	2[2]	1,500	All purpose	Electro-Motive
	11[2]	1,600	Road switch	Alco-G. E.
	5[2]	1,000	Switch	Alco-G. E.
	10[2]	1,200	Switch	Baldwin-Lima-Hamilton
	3[2]	1,200	Road switch	Baldwin-Lima-Hamilton
	1[2]	2,400	Transfer	Baldwin-Lima-Hamilton
	3[2]	1,200	Switch	Fairbanks, Morse
Reading	5[3]	2,400	Road	Fairbanks, Morse
	12[3]	1,500	Road switch	Electro-Motive
	7[3]	1,600	Road switch	Alco-G. E.
White Pass & Yukon	2[4]	800	Switch	General Electric

FREIGHT-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Bangor & Aroostook	5[5]	50-ton box	Pullman-Standard
Canadian National	5	Air dump	Magor Car
Chesapeake & Ohio	5[6]	70-ton hopper	Company shops
Chicago, Milwaukee, St. Paul & Pacific	100[7]	70-ton covered hopper	Pullman-Standard
Clinchfield	100[8]	50-ton box	American Car & Fdry.
Erie	500[9]	50-ton box	Pullman-Standard
	300[9]	70-ton gondola	Greenville Steel Car
	200[9]	50-ton box	Company shops
Gulf, Mobile & Ohio	1[10]	140-ton Depressed center flat	Company shops
	90[10]	50-ton flat	Company shops
Missouri-Kansas-Texas	25[11]	50-ton flat	American Car & Fdry.
Missouri Pacific	100[12]	50-ton pulpwood	Company shops
Pennsylvania	300[13]	70-ton covered hopper	Pullman-Standard
Seaboard Air Line	200[14]	70-ton hopper	Bethlehem Steel
Southern	75[15]	70-ton flat	Thrall Car Mfg. Co.

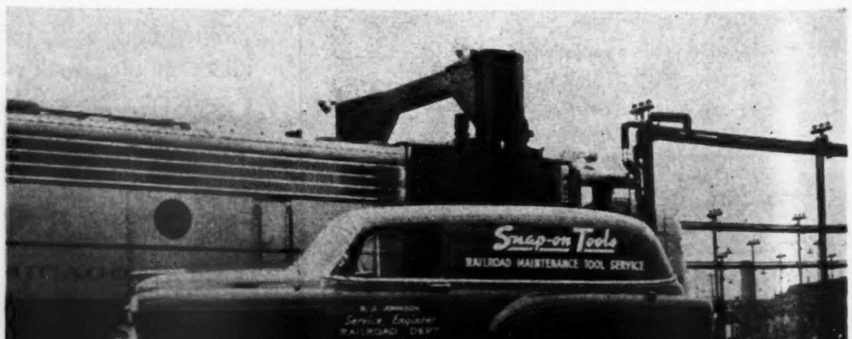
PASSENGER-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Atchison, Topeka & Santa Fe	6	Full-length dome	Budd Co.
Boston & Maine	1[16]	RDC-3	Budd Co.
Chicago, Rock Island & Pacific	2[17]	RDC-3	Budd Co.

[1] Deliveries expected during this month and October. Approximate cost, $700,000.
[2] Announcement of the authorization to purchase this equipment was made in the July issue.
[3] Delivery expected to be completed before the end of October. The order to Fairbanks, Morse is for Train-Master units.
[4] To be equipped with full box cars. For 1954 spring delivery.
[5] For delivery in the first quarter of 1954.
[6] Approximate cost, $6,000 each. October delivery expected.
[7] For delivery next year.
[8] Estimated cost, $600,000. Delivery scheduled for first quarter of 1954.
[9] Deliveries scheduled for early next year.
[10] Delivery of the 140-ton car, (estimated cost, $40,000), expected in the first quarter of 1954. Delivery of the 50-ton cars, (estimated cost $679,500), expected by the end of this month.
[11] For first quarter 1954 delivery. .
[12] Estimated cost, $7,500 each. Delivery scheduled for fourth quarter of 1954.
[13] Approximate cost, $2,300,000. Deliveries expected to be completed early next year.
[14] Approximate cost, $1,300,000. Deliveries scheduled to begin during first quarter of 1954.
[15] To be equipped with roller bearings and cost about $900,000. Deliveries expected to start late this year.
[16] For early fall delivery.
[17] Delivered.

Western Pacific.—Directors of the Western Pacific have authorized purchase of 10 cushion-underframe box cars (PS-1) at a cost of about $7,500 each. Two cars of this type have been in test service on transcontinental runs for several months.

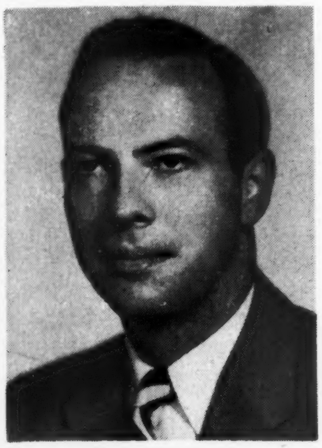
Northern Pacific.—The Northern Pacific plans purchase of 30 diesel locomotive units, comprising 14 1,500-hp. road-switchers, five 1,000-hp. switchers, two four-unit 6,000-hp. freight locomotives, and one three-unit 4,500-hp. passenger locomotive. Cost is estimated at $4,548,000.



Snap-On Tools has inaugurated a new service for diesel and car shops in which a panel truck delivers direct to the shop a complete line of tools on short notice to provide replacements when needed most.

(*Continued from page 100*)

SAFETY CAR HEATING & LIGHTING CO.—*Robert B. Seidel* has been appointed director of research and product development. Mr. Seidel was formerly in charge of research and product development labo-



Harry W. Jones, Jr.

ratory of the Lincoln Electric Company. *J. A. Wiedmann,* manager of the sales service department, has retired. *Harry W. Jones, Jr.,* has been appointed assistant sales manager.

■

NATIONAL STEEL CAR CORPORATION.—*A. P. Shearwood,* vicepresident—sales, Hamilton, Ont., and Montreal, has been

H. J. Lang

elected chairman of the board and chief executive officer, and *H. J. Lang,* vice-president, has been elected president.

■

AMERICAN CREOSOTING COMPANY.—Arrangements have been completed for a new wood preserving and manufacturing plant to be constructed between Binghamton and Waverly, N. Y. The plant, which is expected to begin operation in January 1954, will have access to four railroads. A considerable part of the equipment in the plant will, the company's announcement says, be of a design and construction not heretofore known or used in the industry.

■

CHIPMAN CHEMICAL COMPANY.—*Warren H. Moyer,* vice-president and treasurer of Chipman Chemical Company, Bound Brook, N. J., has been elected president, succeeding *O. M. Bernuth,* who has become chairman of the board.

BALDWIN-LIMA-HAMILTON CORPORATION.—*William C. Vanbebber,* supervisor of renewal parts for Baldwin diesel locomotives for the Pacific Coast district has been appointed sales engineer for Baldwin-Lima-Hamilton testing equipment in Los Angeles and surrrounding territory.

■

RIGIDIZED METAL CORPORATION. *Chicago Steel Service,* Kildare avenue and 45th street, Chicago, has been appointed distributor for Rigidized Metals.

■

ELECTRIC SERVICE MANUFACTURING COMPANY.—*William D. Jameson,* formerly with the *Yale & Towne Manufacturing Co.,* has been appointed general sales manager, and *I. W. Schmidt,* vice-president and former sales directer, directs a new department of market research.

■

WAUGH EQUIPMENT COMPANY-HULSON COMPANY.—The Waugh Equipment Company, New York, has acquired from its subsidiary, the Hulson Company, Chicago, all production and sales rights for the Plypak journal-box waste container and the Hulson and Duryea cushion underframe. Under the new arrangement *John*

(*Continued on page 111*)

(*Continued from page* 107)

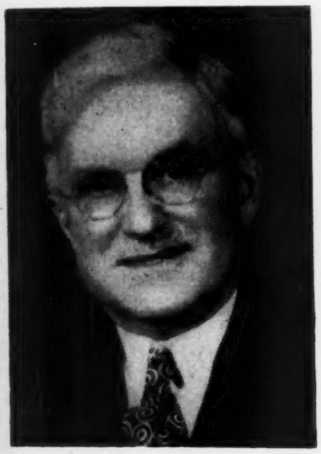
W. Hulson has been elected vice-president in charge of sales of the Waugh Equipment Company at Chicago. Mr. Hulson will continue also as president of the Hulson Company which will continue to manufacture and sell the Hulson 202-A friction draft gear and the Tuyere type grate.

■

Reynolds Metal Company.—*Glen W. Goodloe* has been appointed assistant manager of the Transportation Market general sales organization, with headquarters at 2500 South Third street, Louisville, Ky.

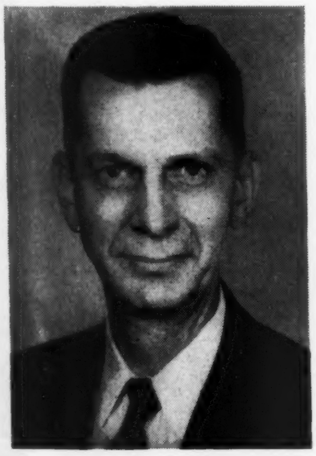
■

National Malleable & Steel Castings Co.—*Dr. Harry A. Schwartz*, manager of research, retired on September 15, but is available to the company as assistant to the vice-president in charge of production,



Dr. H. A. Schwartz

a newly created position. Dr. Schwartz has been associated with National Malleable since 1902. *B. C. Yearly*, assistant manager of the company's Chicago works, has been



B. C. Yearly

transferred to Cleveland as director of applied research, process control and supervisory training.

As part of its program for observing its 85th year in business, National Malleable has established $3,000 in scholarship funds at six educational institutions. The scholarships, for $500 each, are the first to be arranged by the Foundry Educational Foundation, which is developing a nationwide educational program on behalf of the foundry industry.

Graybar Electric Company.—*A. P. Torres* has been appointed manager, Tampa, Fla., branch, succeeding *R. S. Robinson*, who has given up active work because of his health.

■

Oakite Products, Inc. — *J. J. Basch*, Philadelphia manager, has been appointed manager of research and product development and has been elected a member of the executive commitee. *W. A. Baltzell*, southern division manager, has been named assistant sales manager.

■

Spring Packing Corporation.—A new eastern regional office has been opened in the Suburban Station Building, 1617 Pennsylvania Boulevard, Philadelphia.

■

Farr Company. — A southern division sales office has been established in the Sterick Building, Memphis, Tenn., in charge of *Donald Harworth*, southern division sales manager.

Obituary

L. M. Klinedinst, who retired in 1948 as vice-president in charge of sales and director of Timken Roller Bearing Company, died in Canton, Ohio, August 10, of a heart ailment.

PERSONAL MENTION

Atchison, Topeka & Santa Fe

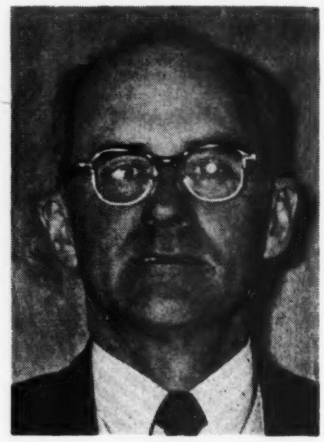
Barton P. Phelps, engineer of shop extensions at Topeka, Kan., retired on June 1.

Peter I. Isaacson, assistant engineer of shop extensions, appointed engineer of shop extensions at Topeka, Kan.

Emmett J. Kelley, supervisor of tools at Topeka, Kan., appointed assistant engineer of shop extensions at Topeka.

Bangor & Aroostock

Vaughan L. Ladd, manager for contract work, appointed mechanical superintendent, succeeding to part of duties of mechanical superintendent and chief engineer, with headquarters at Derby, Me.

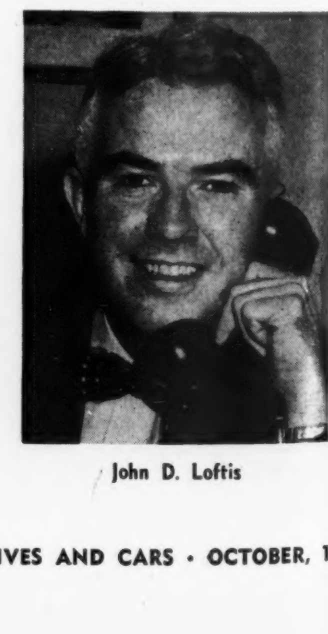


Vaughan L. Ladd

Education: Graduate of University of Maine.
Career: Special apprentice in 1924; mechanical engineer, and superintendent of shops.

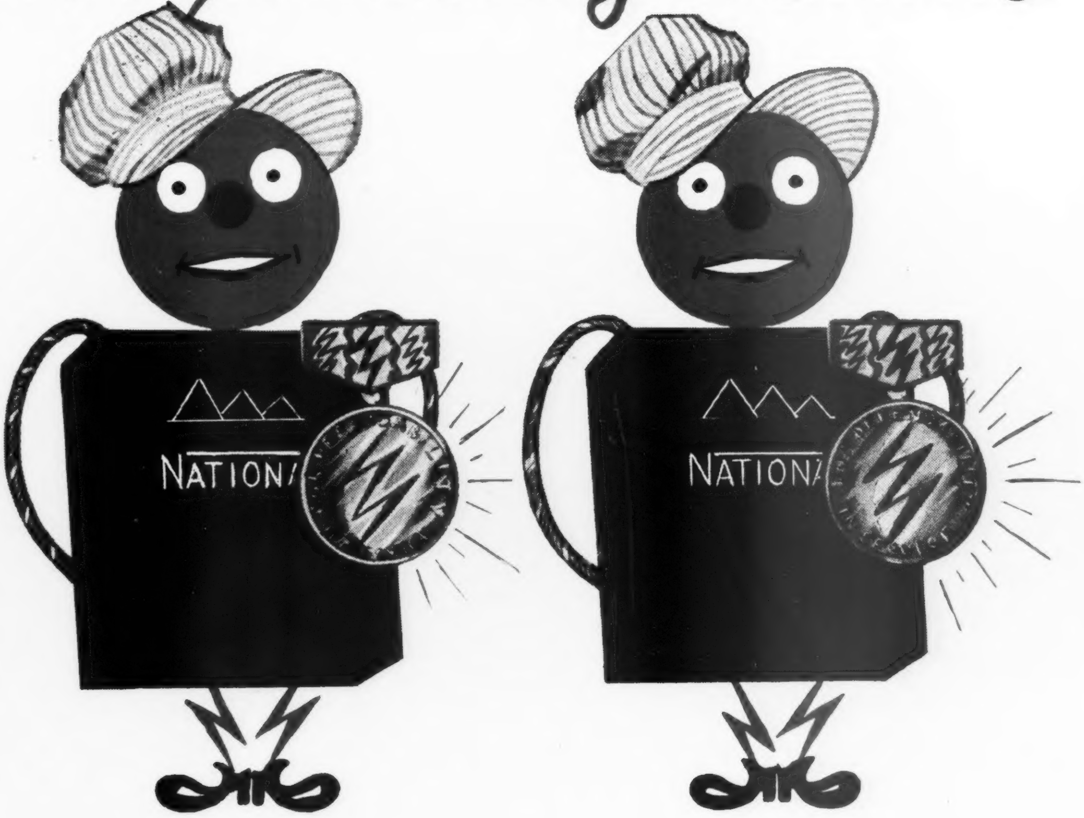
Chicago, Rock Island & Pacific

John D. Loftis, assistant superintendent and chief mechanical inspector, appointed assistant general superintendent motive



John D. Loftis

For Dependability in Service...



NATIONAL BRUSHES FOR DIESEL-ELECTRIC TRACTION MOTORS

TRADE-MARK

Trouble-free diesel-electric operation demands *overall* dependability. That's why "National" traction motor brushes are made strong *all over* to withstand this unusually severe service.

BETTER GRADES...

"National" traction motor brushes combine great *mechanical strength* with low friction, optimum film-forming and commutating properties. They are highly resistant to chipping and breaking...keep 'em rolling even under extremely adverse conditions.

STRONGER CONNECTIONS...

"National" *permanently-sealed* shunt connections have virtually eliminated pull-outs in traction-motor service. Here's another source of frequent mechanical failure licked by exclusive "National" brush design.

TOUGHER CABLES...

Standard on most traction motor brushes, the new Type "National" FP cable is tested to give *many times* the fatigue life of any other cable now offered. Here's relief from costly failures due to frayed, broken or damaged cables.

The term "National", the Three Pyramids device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation

30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon Limited, Montreal, Toronto, Winnipeg

power as announced in the August issue.

Career: Began in 1928 with the Denver & Rio Grande Western. In 1943 joined the Baldwin Locomotive Works in Cleveland as manager, becoming regional manager in 1944. Appointed general superintendent motive power of the Atlantic Coast Line in 1945 and chief of motive power and equipment for that railroad in 1947. Joined the Rock Island in 1952, serving successively as trainmaster, assistant superintendent and chief mechanical inspector.

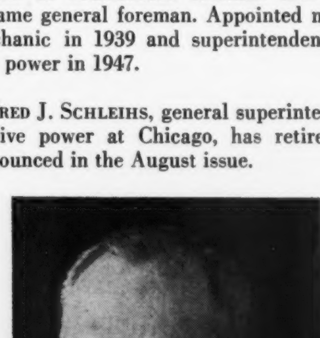
MELVIN R. WILSON, master mechanic at Silvis, appointed general superintendent motive power at Chicago as announced in the August issue.

Career: Entered railway service in 1915 as machinist apprentice for the Wabash. From 1919 to 1924 served in a number of

Melvin R. Wilson

capacities with the Missouri-Kansas-Texas, the St. Louis-San Francisco, the New York Central and at the Washington, D.C., navy yard. In the latter year joined the Rock Island as roundhouse foreman and later became general foreman. Appointed master mechanic in 1939 and superintendent motive power in 1947.

FRED J. SCHLEIHS, general superintendent motive power at Chicago, has retired, as announced in the August issue.



Fred J. Schleihs

Career: Joined the Rock Island in 1916, and has held mechanical positions at Des Moines, Iowa; Silvis, Ill.; Blue Island, Ill., and Dalhart, Tex. Last year appointed general superintendent motive power.

MARION C. SHARP, assistant general superintendent motive power, appointed superintendent motive power, with headquarters at El Reno, Okla.

Career: Entered railway service in 1922 as messenger in the Rock Island stores department at Little Rock, transferring to the mechanical department in 1923 as machinist helper apprentice, later becoming machinist. After two years (1940-1942) with the Union Pacific, reemployed by the Rock Island as assistant diesel supervisor. Appointed diesel supervisor in 1943, superintendent automotive equipment in 1946, assistant to general superintendent motive power in 1950, and assistant general superintendent motive power in 1952.

Boston & Maine

W. H. OHNESORGE, superintendent of shops at North Billerica, Mass., has retired.

E. C. CONE, assistant superintendent of shops at North Billerica, Mass., appointed superintendent of shops.

Canadian National

H. H. HICKS, acting general superintendent motive power and car equipment, Atlantic Region, at Moncton, N. B., appointed general superintendent motive power and car equipment, Atlantic Region.

CHARLES T. RIDEOUT appointed mechanical department staff supervisor, Atlantic Region, with headquarters at Moncton, N.B.

Canadian Pacific

A. LANGDON, division master mechanic at Calgary, Alta., transferred to Saskatoon, Sask.

O. COCHRANE, division master mechanic at Saskatoon, Sask., has resigned.

F. G. NOSEWORTHY, division master mechanic, transferred from Winnipeg, Man., to Kenora, Ont.

R. G. THOM, division master mechanic, transferred from Regina, Sask., to Winnipeg, Man.

J. DAVIES, locomotive foreman at Kenora, Ont., appointed division master mechanic, with headquarters at Regina, Sask.

Chesapeake & Ohio

S. G. GUINS, research engineer, appoined assistant to the director of research at Cleveland.

G. J. SENNHAUSER, locomotive development engineer, appointed design and development engineer at Cleveland.

J. A. KELL, analysis and test engineer, appointed assistant research engineer at Cleveland.

New York Central System

MICHIGAN CENTRAL DISTRICT

R. B. OLSEN appointed road foreman of engines, Canada Division, with headquarters at St. Thomas, Ont.

WILLIAM KELLY, road foreman of engines, Canada Division, at St. Thomas, Ont., has retired.

H. T. LOCKWOOD appointed assistant road foreman of engines, with headquarters at St. Thomas, Ont.

EQUIPMENT DEPARTMENT

G. C. CHURCHER appointed general apprentice instructior, with headquarters at New York.

Newburgh & South Shore

R. B. KLEINFELD, superintendent motive power and equipment at Pittsburgh, Pa., has retired.

H. C. KERFOOT, appointed superintendent motive power and equipment at Pittsburgh, Pa. Mr. Kerfoot is also superintendent motive power and equipment of the Lake Terminal at Lorain, Ohio.

Pennsylvania

J. P. FRANCIS, assistant superintendent at Chicago, appointed superintendent motive power—diesel at Chicago, as announced in the July issue.

Career: Began with the PRR in 1931 as special apprentice. Later held the successive positions of gang foreman, enginehouse foreman, foreman enginehouse and

car shops, assistant foreman, enginehouse foreman and master mechanic. In 1952 appointed assistant superintendent at Chicago.

L. R. YOAKAM, foreman, Scully car shop, Panhandle Division, appointed foreman, Pittsburgh passenger yard, Pittsburgh Division.

J. V. THOMAS, JR., assistant foreman, Mahoningtown, Pa., Lake Division, appointed foreman, Scully car shop, Panhandle Division.

R. P. PHILLIPS, gang foreman, Conemaugh Division, appointed assistant foreman, Mahoningtown, Pa., Lake Division.

R. E. MINOR, night assistant foreman, Erie car shop, Northern Division, appointed assistant foreman, Erie car shop, Northern Division.

H. W. COLLINS, gang foreman, Conemaugh Division, appointed acting foreman, car repairs, Conemaugh Division.

T. R. LONG, relief gang foreman, Erie car shop, appointed night assistant foreman, Erie car shop, Northern Division.

Reading

W. A. W. FISTER, chief draftsman, appointed assistant superintendent motive power and rolling equipment, with headquarters at Reading, Pa.

Seaboard Air Line

J. G. CASON appointed supervising electrician at Hamlet, N. C.

REUBEN M. HIGGINS, superintendent of car department at Norfolk, Va., has retired.

H. E. AENCHBACHER, assistant shop superintendent at Jacksonville, Fla., appointed superintendent of shops at Jacksonville.

HENRY W. JARRETT, assistant to chief mechanical officer at Norfolk, Va., has had duties extended to include all car department matters.

Southern

JAMES N. HARLING appointed foreman enginehouse (night) at Columbia, S. C.

W. DOT SHULTS appointed master mechanic at Macon, Ga.

WILLIAM B. DOBBS appointed foreman electricians at Birmingham, Ala.

STANLEY G. HOGAN appointed foreman electrician at New Orleans, La.

ARCHIE G. WALDRUPE appointed assistant master mechanic at Atlanta, Ga.

MARION D. SWYGERT appointed foreman pipe and tin shop at Columbia, S. C.

OSCAR T. HARMON, JR., appointed assistant roundhouse foreman (day) at Chattanooga, Tenn.

WALTER C. LOMAX, JR., appointed assistant foreman car repairs at Spencer, N. C.

PERSONAL MENTION—Obituary

J. A. DOARNBERGER, who retired in 1938 as master boilermaker of the Norfolk & Western, died on August 18 at the age of 86. Mr. Doarnberger was the first president of the Master Boiler Makers' Association and for five years was chairman of the Executive Board of the association. He held patents for several locomotive firebox inventions.

JOHN W. HOWARD, division car foreman of the Delaware & Hudson at Carbondale, Pa., died on August 20.

New Devices

(Continued from page 94)

hydraulic ram pump, powered by an ordinary automotive storage battery which forces grease through a 25 ft. reinforced hose to a universal grease gun handle where greasing pressure can be varied from 600 to 12,000 lb. per sq. in. A standard automotive starter supplies mechanical power.

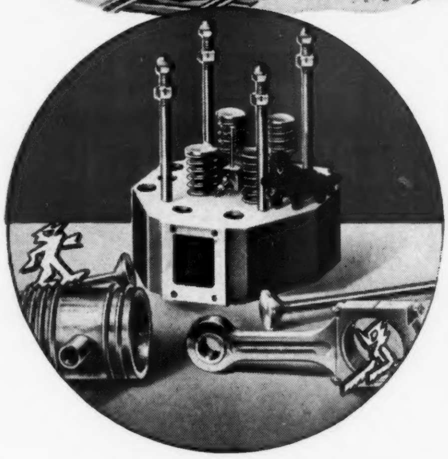
Two models are available. Model A-100 fits drums of 14¾ in. maximum outside dia. and minimum depth of 22 in. Model A-110 fits drums of same diameter but of at least 26 in. in depth. Total weight of unit is 400 lb.

■

Automatic Flange Lubricator

A fully automatic flange lubricator has been developed by the Rail & Flange Lubricator Co., 2784 N. W. Thurman street, Portland 10, Ore., which lubricates the wheel flanges from the locomotive on back through the cars as well as the pressure side of the rails. It does this without getting lubricant on the surface of the track or the tread of the wheel.

The lubricator deposits on the flanges of the wheel a heavily graphited grease which in turn is rubbed into the pressure side of the rail. Four lubricators are use l



On the main line or in the yards, your Diesel engines are constantly faced with the ever-present menace of WEARMITES ... Grit, Dust, Dirt and Tarry Sludge. Lubricating oil and Fuel oil must be freed of these engine-destroying contaminants if costly repairs and down time are to be avoided.

WIX ENGINEERED FILTRATION is the practical, effective and economical means for combating WEARMITES in your Diesel equipment. With WIX Cartridges in your Diesel Filters, you are assured a constant flow of continuously cleaned oil ... cleaned better ... kept clean longer. And you may select the filtrant indicated as best for the type of service condition such as: long haul, through run, stop-and-go branch line or yard work.

Write for particulars on how your road can save lubrication dollars with WIX ENGINEERED FILTRATION.

Precision construction ... controlled density ... uniform quality ... self-contained sealing gaskets ... a filtrant best suited to the service and many other WIX *plus* features add up to WIX Engineered Filtration. Whether for Lubricating or Fuel Oil, crush-proof, non-collapsible WIX Filter Cartridges show a decided dollars and cents advantage for you.

ENGINEERED FILTRATION

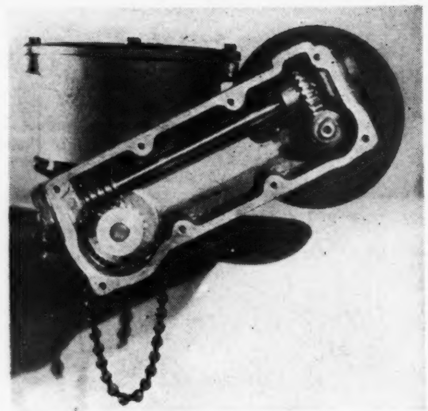
wix
TRADE MARK REG.

LUBE **FUEL**

RAILROAD OIL FILTERS

WIX CORPORATION · GASTONIA, N. C.

WAREHOUSE STOCKS IN: GASTONIA · ATLANTA · CHICAGO · NEW YORK · ST. PAUL · ST. LOUIS · SACRAMENTO



400 to 500 miles of operation. Normal maintenance consists principally of cleaning, which can be done in about 15 minutes during monthly or quarterly inspection.

Rectifiers for D.C. Power Supply

Selenium-type rectifiers in standard units ranging in size from 3 to 5 kw. are now being supplied by the American Rectifier Corporation, 95 Lafayette street, New York. They are made for 50 to 10,000-volt d.c. output with either fixed or variable voltage, and for operation from any a.c. voltage or frequency. Rectifiers in sizes up to 1,000

per locomotive unit. A set of two is used at each end of a switcher, one on either side. On road locomotives, two are mounted on the lead wheels of each truck.

The deposit of the graphited lubricant is made by an endless roller chain assembly which runs through a grease reservoir. The chain is adjusted to eliminate getting the lubricant on the tread of the wheel or the surface of the track. It is driven by a friction wheel from the locomotive wheel through double reduction gearing. The deposit of the lubricant is made by the lateral movement of the wheel and the sway of the chain.

The cost of the graphite lubricant averages approximately 22 cents per day per locomotive. The lubricator can be filled in about a minute with enough grease for

kw. are engineered by the manufacturer to meet specific requirements. The unit shown in the illustration is rated 20 kw. Ventilation in the larger units is supplied by motor-driven fans.

■

Self-Adhesive Aisle Markers

These aisle markers, which feature simplicity of application, are made of a durable plastic, backed with pressure-sensitive adhesive. Stocked in four colors, caution yellow, fire red, safety green and neutral white.

Marketed by the W. H. Brady Company, Milwaukee 12, Wis., the markers will stick to any clean, dry floor without moistening. Resistant to abrasion, acids, oil, grease, salts, water and most common solvents, they lie flush with the floor, being only 0.005 in. thick.

The markers are recommended for industrial plants, offices, warehouses, hazardous areas, power houses, etc. They are mounted on a 2-piece folded paper liner and are available in 2, 3, 4, and 5 in. diameters.